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Rev. Howard E. Walther, D.D.

SCIENCE AS REVELATION

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SCIENCE AS REVELATION

BY

JOHN M. WATSON

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To My Mother, Who Taught Me to Love the Good and the True; and to My Father Who Taught Me to Think for Myself.

PREFACE

Since my boyhood I have had a growing conviction that the truths of nature must constitute a dependable revelation of the Divine way and will.

For nearly twenty years under the religious instruction of a most devout and sincere minister of the gospel, I reached the years of my majority well grounded in orthodoxy. But at the same time I became interested in the study of nature, and then and since I have delved delightfully in the sciences. As I have learned more of the facts of nature I have learned to depend more upon natural law as the sure and safe expression of Infinite Will. My own life's experience is therefore the basis of the line of thought presented in the following pages.

I have a growing conviction that the moral or religious impulse has a truly scientific basis, and that our creeds can be refined and purified to harmonize with the truths of nature. I have acquired for myself a newer, higher, holier view of religious faith, one that is satisfactory to the intellect as well as to the heart.

The scientist will observe that this book is written for the layman. It is not a text book on science. While the major sciences are discussed, the treatments are necessarily brief. To fill in all the gaps

and elaborate these sufficiently to make them acceptable to the scientist would make the work uninteresting to its intended readers. I have used language and comparisons that will be understood by the layman, rather than those which would be in order in a discussion before a body of scientists. Scientific non-essentials, if such a term may be excused, are sacrificed in order to present the outline of the main theme in a manner agreeable to the non-scientific mind. Yet the layman may rest assured that the treatments of the sciences agree in all essentials with the accepted authorities in the various fields of research.

I wish to emphasize, also, for the benefit of the lay reader, the fact that science does not claim to have any final knowledge in any department of research. On the contrary, we know but very little. No one realizes so well as the scientist himself the innumerable questions that remain unsolved, and the infinite complexities that are involved in an outline so comprehensive as this one. New discoveries of truth at any time may be so basic as to be truly revolutionary and may expose a fallacy in what had formerly been accepted as truth.

What follows in this book is therefore not to be considered as possessing any quality of finality. The reader should consider it as based upon our present knowledge only, which we must all recognize is doubtless far from the ultimate truth of nature. Scientific research has made wonderful progress in the last fifty years, overthrowing many

beliefs that were formerly apparently secure. The law of probability indicates that in the future the process will be repeated with respect to our present beliefs.

Therefore, there is no claim to finality in what follows. But we cannot suspend judgment and wait for future centuries to reveal more of the truths of nature. We are living now. The best we can do is to consider and decide upon the basis of the latest and best scientific and philosophic thought. This I endeavor to do in simple language in the following pages.

I should very, very much regret if anything I have felt compelled to say should bring pain to any one. That is furthest from my desire or purpose. I sincerely hope that my thought may prove constructive and helpful. But the subject and the times require rigorous thinking and plain speaking. If the truth be told it should not hurt; if what is said be untruthful it cannot injure any but

THE AUTHOR

CONTENTS

CHAPTER		PAGE
I.	Introduction	17
II.	The Astronomer Speaks	26
III.	The Physicist Speaks	47
IV.	The Chemist Speaks	76
V.	The Biologist Speaks	96
VI.	The Geologist Speaks	133
VII.	The Paleontologist Speaks	139
VIII.	The Anthropologist Speaks	146
IX.	The Psychologist Speaks	181
X.	The Voice of Ethics	206
XI.	The Philosopher Speaks	238
XII.	The New Religion	264
XIII.	The New Revelation	289

LIST OF PLATES

PLATE		TO FACE PAGE
I.	The Pleiades	28
II.	A Star Cloud in Sagittarius	39
III.	Spiral Nebula H. V. 19 in Andromeda	40
IV.	Star Cluster M 13 Hercules	42
V.	The Great Spiral System in Andromeda	44
VI.	Arrangement of Electrons in Atoms	62
VII.	Photograph of Prominences on the Sun	72

"To Science, Pilot of Industry, Conqueror of Disease, Multiplier of the Harvest, Explorer of the Universe, Revealer of Nature's Laws, Eternal Guide to Truth."

* * * * * *

"The search for truth is in one way hard and in another easy. For it is evident that none can master it fully nor miss it wholly. But each adds a little to our knowledge of nature and from all facts assembled there arises a certain grandeur."

(Inscriptions at the
National Academy of Sciences,
Washington, D. C.)

SCIENCE AS REVELATION

CHAPTER I

INTRODUCTION

LAW, ORDER, COSMOS, GOD

In the beginning, God.

Just here I must ask the man who cannot conceive of a personal God not to take issue with me first thing over the idea of Deity. That idea will be discussed later in the book. And I dare hope that by the time we are through with the subject, if together we can give the matter in hand fair, open-minded consideration, we shall arrive at a mutually satisfactory understanding.

And the religionist with established, even if vague, ideas of God, him I would remind that no finite mind can comprehend the Infinite. Our ideas of God must necessarily be exceedingly faulty, and based—not on the Infinite—but on notions handed down to our faulty minds by other faultier minds. Necessarily the result cannot be an accurate conception of Deity.

So if the reader is to be fair to the subject, fair to himself and fair to me, he will keep his prejudices in check throughout the reading of the book

and base his final decision strictly upon the evidence by the soundest judgment of which he is capable.

For any attempt at a sane consideration of religious questions by the above method is necessarily of a philosophical nature. Yet comparatively few people are prepared by education or training to deal with philosophical considerations. They cannot philosophize for themselves, and they make little attempt to do so, for it means too much study and hard work. It is much easier to keep on accepting the ideas that have been passed down to us. But our creed could be made much more logical, more beautiful and more convincing if we gave Divine Truth a new interpretation in harmony with modern knowledge.

Among all the psychic experiences of mankind religion occupies such a prominent place that it commands attention. Few other phenomena of the higher mental and moral activity of man can compare with the natural impulse to worship the Creator of all things and to strive to live in harmony with Divine Will. Praise to the All-Wise, All-Powerful, and veneration for the incomprehensible works revealed in man and throughout the universe are as natural as life itself. Some one has said that, "Man is incurably religious." I hope he will never be "cured" of the religious impulse. But some one else has more accurately expressed the thought intended in the words, "Man is incorrigibly theologi-

cal." That is a very different thing, too true, and the curing of it very much to be desired.

We must recognize at the start that religion is a great reality in human experience. It is man's attempt to know more and more of the Infinite, to put himself in closer and closer touch and harmony with the God of Creation and Providence, and to express in words his conceptions of Divinity. All peoples, all tribes, all nations, throughout all time have sought for a better knowledge of the way and will of God; for a higher state of perfection for themselves, because it meant a closer approach to the All-Perfect.

True religion is a properly respectful and appreciative attitude toward the One, Great, Original Cause, the Creator of All Things; and toward the laws which indicate the manner by which the works of creation are accomplished.

But the different ideas of Infinity, or of God, are about as numerous as the minds that attempt their contemplation. When we remember that finite mind can never comprehend the Infinite, as well as the other equally important fact that the human multitude look upon the works of the Creator and the Creator's laws with minds of which no two are alike, then the reason for great differences in our final conclusions is apparent.

What is needed is an organized system in our thinking pertaining to that Supreme Cause which we may call God, based on the established things of nature, the laws by which the works of creation

have been produced and are being maintained. Such established facts of this kind as are available, properly organized and correlated, ought to give us the sanest possible conclusions regarding our attitude toward the Infinite Power and the universe.

Nevertheless, the problem is an exceedingly difficult one. From the very beginning our notions concerning the Infinite Power, which we call God, are extremely vague and varied. We say that, "God is a spirit, infinite, eternal and unchangeable." Yet we speak of "Him" and give our God a manlike personality. Infinite, eternal, unchangeable, omniscient, omnipotent and omnipresent, yet manlike; a paradox—absurd, preposterous, impossible.

If we want to make progress along lines of sound thinking and eventually arrive at the most nearly correct idea of which we are capable concerning the Supreme Cause and our relation to the All-Wise and All-Powerful Creator, then *we must by force of will compel ourselves to disregard for the time at least, many of our old notions concerning Divinity.* We must get back to nature, back of nature to nature's laws, back of creation to the Creator, to the Cause of Creation—back to God—and base our thinking upon the very soundest fundamentals.

If we are to have a proper respect for the Creator of All Things, then it is obvious that we must be respectful of the Creator's works. The religionist who refuses to listen to what the astronomer has learned as to the structure and operation of the cosmos; who will not consider what is going on in

the nebulae, in the suns and stars and in the great spiral systems of worlds; who refuses to interest himself in the latest discoveries of the physicist; who is ignorant of the basic principles of chemistry; who utterly ignores and refuses to believe the established laws discovered by the biologist—is not only untrue to himself as a man but is untrue to the Creator and the created works of the universe. For if we be perfectly sincere in wanting to know more of that Creator, how can we fail to interest ourselves most deeply in the beauty, the order, the law of the Creator's works all about us?

We profess to want to know more of the will of God and to shape our lives into conformity therewith. Can we call ourselves really sane-minded men and neglect to consider the laws of the Creator as clearly revealed in the very air we breathe, the earth we tread upon, in all the elements of which it is composed, in the myriad animal and vegetable life about us, and in the very sun that warms us and in the millions of stars that surround us? If we consider that question for a moment it will be perfectly clear that true religion *cannot* be in the slightest way in contradiction with the works of the Creator, or the laws by which the creative will is carried out.

Were we truly religious we would appreciate to the full the sublimity of Truth, wherever it is found throughout the cosmos; and to attain the fullest possible knowledge of Truth and to achieve the utmost harmony with it would be life's one great aim.

The Beautiful, Wonderful Works of Creation

The student of the sciences sees in Astronomy, in Physics, in Chemistry, in Biology, in Psychology and in Ethics, wonderfully complex yet perfect systems, all together making an orderly, lawful, beautiful cosmos that compels the highest wonder and admiration. The cosmos so pictured at once suggests a Supreme Intelligence of an order far higher than anything we can otherwise conceive. Thus the sciences, instead of being irreligious in their influence, inspire in the scientist a reverence of the sincerest and highest order. A recognition of this fact prompted some one to say that, "An undevout astronomer would be mad."

In the recent past there has been entirely too much loose talk about the conflict between religion and the sciences. That a conflict has been going on cannot be denied, but it has been the conflict of scientific truth with our antiquated theology rather than with religion. For science is truly religious. That there is *in the nature of things any just reason* for such conflict (unless it be our own ignorance), cannot be too emphatically denied. The laws of nature as revealed by the sciences are but the will of God. That these laws should be in conflict with the laws in operation in other sectors of Divine Truth, for instance, the fundamental moral laws for which Christianity and the church aim to stand, is absolutely contrary to all just ideas of the Creator and

his work, contrary to all logic. Such a position is utterly untenable, unreasonable; a bare idea which, if we think, is preposterous. And yet this unsound idea has been given a home in the minds of men for centuries!

In the following chapters I shall hope to present viewpoints which will enable us to see this truth in a new light, and open a way whereby we may come into closer harmony with infinite will, and realize our true relation to the Omnipotent. I hope to accomplish this by means of a consecutive chain of sound reasoning, based not only upon the material sciences, but also upon sound moral concepts and the important teachings of Jesus Christ.

This consideration will consist of a continuous web of thought, beginning at the very bottom of the ladder of energy; the primary energy forms; the primary physical forms; the atom, the structure and the energy of atoms; the evolution of the elements, and their various energy manifestations; chemistry with its more intricate compounds of the primary elements and the development of its new energy forms; biology and numerous new life energy forms; psychology and again new forms of energy in manifestation; to the realm of ethics and religion, the highest of all sciences. Thus I hope we may be led to a worship of the Infinite in a new faith, based, not upon unknown authority, but on real knowledge, and the satisfaction of a new understanding of the Supreme Authority.

Throughout history, science and education have

ever and again purified and elevated and beautified religious thought and thus saved it from stagnation and decay. Today our religious thinking is again in need of a new purification; and thanks to knowledge only recently available we may approach the renovation of religion and the worship of the Creator more intelligently and with better prospects than ever before. The scientific viewpoint today can impart to religion a new purity, a new beauty, a new sublimity and a new stability that were impossible under the old interpretations. By the ladder of the sciences we may rise step by step, without the slightest break or gap, from the simplest form of matter and energy and from nature at its zenith obtain the most sublime, beautiful and uplifting religious concepts.

For science, in its delvings into the unknown, is ever coming nearer and nearer to the Great First Cause, and thus nearer to the true fundamentals of religion. And this is as it should be. For if we are really sincere in wanting to know the way and will of the Creator of all things, what better can we do to ascertain that way and will, than to make a closer and closer study of his works? Our study must cover not only the works of creation of millions of years ago, but the works of creation and providence today as revealed throughout nature, including man and the mind and spirit of man.

Science has thoroughly revealed many established natural laws. These natural laws reflect the Supreme Will. We know no beginning of them, we

can conceive of no end. They are "infinite, eternal and unchangeable." The laws of nature are the thoughts of God, the plan upon which all the works of creation and providence are executed. To know them fully would be to really know God.

Man's interpretation of the way and will of God in the past has been correct in its fundamentals to a degree that is remarkable when we consider the meager sum of human knowledge available to the early interpreters. It was as if the vision of the poet or prophet, even with but scanty knowledge of nature's laws, should by a sixth sense divine something of the destination without knowing anything of the road by which that destination is reached. Today we know the road much more thoroughly and we can state our new creed with the satisfaction that goes with much more complete understanding.

But we must proceed step by step. To lay the foundation for the maturer thought to be presented in the latter part of the book I ask your patience to bear with me in a very brief presentation of some of the pertinent facts of some of the physical sciences. Before getting to the ultimate subject it will be necessary to take a brief survey of the outstanding features of Astronomy, Physics, Chemistry, Biology, Geology, Paleontology, Anthropology, Psychology and Ethics, and the nature and characteristics of Truth itself. And through it all we shall discover law, order, cosmos, God.

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CHAPTER II

THE ASTRONOMER SPEAKS

Law, Order, Cosmos, God

The science of Astronomy is fundamental to our inquiry. It is so all-comprehensive in its scope and has such direct bearing on the subject in hand that some of its more important facts must be presented here. At the same time space requires that the presentation of the subject be brief, and only a few of the major facts pertinent to the main theme will be presented. The reader who wishes to pursue this very interesting science further will find a vast amount of more detailed information in support of what is here set forth.

The Life History of Worlds

Gaseous nebulae are widely distributed throughout the starry heavens, but are more frequent near the regions of the Milky Way. They represent the original raw material out of which the stars are made. We use the word "original" in a relative sense, for all things that exist, including the stars and the nebulae, are in a continual process of change. Obviously any one point in a cycle is just as "original" as any other point, but in discussing

the subject, "The Life History of Worlds," the nebulae serve as a logical starting point.

For stars and worlds are born, and live, and change, and die, even as all things else must do. With the stars a thousand years is as but a day, and vast eons of time are necessary to complete the life cycles of the suns. And these immense suns, millions, billions, unnumbered and innumerable, are themselves organized into larger units of varying design, size and structure that go through a process of change—concentrates of matter and energy, though they be on a scale so grand, so magnificent, so sublime in all their immensity, that our poor, puny minds cannot begin to grasp the significance of it all. "The wisdom of man is but foolishness with God."

Probably you are familiar with the little group of stars known as the Pleiades. If not, you ought to be. Get out your telescope or opera glass. They lie between the larger constellations Orion and Taurus, and are found near the meridian almost overhead in the evening hours in November. The group forms a cluster so close and compact that a good eye is necessary to separate the six principal stars, but with an opera glass on a clear night when the moon is not in the sky they are an inspiring sight. Besides the six the eye sees, there are forty-five other stars in the group. While you are looking at them reflect that each of the six bright stars is about one hundred times as bright as our sun.

Turn a big telescope on this cluster of stars and

photograph what it reveals and the close relationship that exists between the stars and the gaseous nebulae becomes apparent. For the principal stars in this group are surrounded by a considerable volume of nebulous, gaseous matter which it seems clear that gravitation has not yet pulled down into the body of the suns. While there are technical spectroscopic evidences showing that some of the Pleiades are rather far advanced in stellar evolution, this need not be gone into here. The group and the surrounding nebulae, for the reason that they photograph unusually well, may serve to typify to the eye a relatively "early" type of stars.

By means of that marvelous instrument, the spectroscope, it is now possible to analyze the contents of a star, ascertain the elements of which it is composed, and the relative quantity of those various elements. We can peer into the very life processes of the stars, watch their changes day by day and year by year, and witness the birth and evolution of the very elements of our chemistry text books. We find the stars are of various temperatures, contain varying quantities of the elements, and exhibit a wide range as to size, complexity of structure and age. Such investigations are highly technical and only the briefest outline can be given here.

The stars are classified according to temperature and spectral type, which may be considered as evidences of age, into six general classes; B, A, F, G, K and M, but the classification is refined into many subclasses. The type B stars are the hottest, bright-

PLATE I. The Pleiades as photographed at Yerkes Observatory with the 2-foot Reflector.

est, and simplest in their make-up, containing fewest of the elements, practically nothing indeed but hydrogen. The A stars are a little cooler, a little less bright, with more lines in their spectra, which means more elements in their composition. The other stars are still cooler and less bright in the order named, with ever increasing numbers of elements also revealed by their spectra.

Only a few of the very simplest of the elements, such as hydrogen and helium, as will be shown more fully in the chapter on Physics, are found in the gaseous nebulae, and in the very hottest Class B stars, such as Gamma Argus or the Orion stars. These intensely hot suns are throwing off and exporting energy into space, just as our sun is radiating energy; and since that the law of conservation holds, the amount of energy left in the stars must be decreasing. But, such is the tremendous volume of the stars that, even though the amount of heat they are throwing off is enormous, still long periods of time must elapse before enough heat shall be lost to lower the temperature of the hottest stars sufficiently for them to be classed among those of second rate luminosity.

If, now, we pick out other stars that are somewhat older and have progressed further in the evolution of star life we find new and different conditions. Suppose we take the Class A star, Sirius. Sirius is "older" than Gamma Argus or the Orion stars, yet comparatively young as star ages go. The spectrum of Sirius shows a decided advancement in

stellar evolution, yet it is composed like the hotter stars, principally of hydrogen and helium, no metals being present.

The next in order, the Class F stars, are characterized by an abundance of calcium. There are also evidences that metals are about to be developed, but they have not yet fully arrived. In other words, the spectra of stars of Class F do not show the complete metallic lines, although enough of them are discernible, the "enhanced" metallic lines, to indicate which metals are next due to be born.

Examine the spectra of the Class G stars such as Polaris, our North Star, Aldebaran, Procyon, Arcturus or the Sun. These stars are still cooler than those previously mentioned in which only a suspicion of the metals is found. In all the stars of the sun class, which may be called the metallic stars, many of the known metals are clearly shown. These stars have advanced very far in their life history, in their evolutionary development, from the time of their youth when they were in the condition of Gamma Argus. Not all of the known elements are found even in the stars of the last mentioned class but their spectra betray the presence of many elements, also the "enhanced" lines indicating still other elements about to be developed. For instance, in the spectrum of our sun only a comparatively few of the lines of iron are yet found, though these are sufficient to show clearly that iron is present.

If, now, we examine the spectra of the older, cooler stars of Class K, hydrogen is found to have

become so reduced that it is less conspicuous than some of the rising metallic lines. And next, in class M stars, the old red dwarf stars, very decided additional changes are noted in the spectra. Still newer elements of greater atomic number are here found, and those elements which predominated in the hottest stars are no longer present. All the simpler elements, such as hydrogen and helium, have apparently been used up in the development of the newer and more complex elements that have come on the scene. In fact, as we survey in review this whole life history of the evolution of the stars, the spectroscope reveals clearly that as the stars cool and become older, elements of more complex atomic structure and higher atomic weight are developed in them.

In perfect harmony with this principle of the evolution of the elements in the suns are the remarkable changes that take place in some of the variable stars, for there are thousands of stars of varying brightness. Some vary periodically, the periods ranging from less than a day to over two years; others vary irregularly. In some the period of maximum brightness is several times as long as the minimum; in others the minimum brightness is the normal condition.

Some of these variables at their maximum brightness are classed with the very hottest of the stars. At such times their spectra show the presence of practically nothing present in them but hydrogen and helium gas, and they belong to star types B

or A. But the spectra of these same stars at their minima, a comparatively short time after, contain lines of other elements, and the stars then belong to classes F or G. Later they return to the other state. These changes back and forth are repeated over and over again.

Proceeding beyond the dwarf stars of Class M, which are old red stars of weak luminosity, next come such bodies as Jupiter. Jupiter has cooled to the point where it is no longer entirely gaseous. A great volume of the former gases have condensed into liquid form and apparently some of the liquids have condensed into solids. In fact, about forty years ago a dark red colored mass known as The Great Red Spot was discovered on Jupiter which has been observable there ever since. This spot is about thirty thousand miles long, and about seven thousand miles wide. Apparently it is a continent of solid matter forming on the planet.

Jupiter has but little luminosity of its own, and it is well on its way toward a time when it will be such a planet as the earth, even though it is about 1350 times as large. The actual age of Jupiter is probably the same as that of the earth, but Jupiter is much hotter still on account of its greater mass. After a sufficient passage of time Jupiter will be a solid planet like the earth. So, if we wish to consider the next step in the life history of worlds, the earth will do very well for the example.

In the earth inorganic evolution has reached the point of producing nearly one hundred elements.

Some of these elements are of great atomic complexity, so much so that they are exceedingly unstable and their own internal energy breaks them down. These are the so-called radioactive elements, those with atomic numbers above 87.

In the earth energy and matter are found in many different forms not found in the hotter celestial bodies. Here are solid rock forms of inconceivable variety with their varying characters as to hardness, texture, beauty, etc. A great variety of new substances, have also been produced by the chemical combination of the elements in different ways, proportions, etc. And earth has two large new classes of things—innumerable vegetable and animal organisms, with wonderful variety of structure and display of energy that are not found, and could not exist, on the hotter bodies.

These two great classes of living organism, like all else, are themselves seen to be undergoing change. Paleontological investigation shows that in times past there have lived upon the earth a great many living forms, both vegetable and animal, which have long ago become extinct. Likewise, present living forms are seen to be undergoing change of structure in adaptation to the changing conditions surrounding them, and others, such as the bison and the passenger pigeon, are becoming extinct in our own time. But further consideration of these facts belongs in a later chapter.

At the present time the earth has progressed in its evolutionary history to the point where little of its

original internal heat is left, though it keeps producing internal heat by gravitational compression. If it were not continually warmed by the sun the earth must soon export by radiation practically all the balance which it has left of its own heat and turn into a cold, lifeless world. That time is far, far off, but it is surely coming; and when that time has arrived the earth will then be such a world as the moon now is—cold, silent, dead.

The last steps in the biography of a world may therefore be well typified by the moon. Our moon is so small that the gravitational attraction is not sufficient to hold an atmosphere or water vapor. It therefore has no water, no air, and thus no possibilities of such life as we have on the earth. When the earth is no longer the beneficiary of life energy from the sun and is passing into the final stage of a world in evolution, its gravitation will still hold a part of its moisture. But the temperature of that moisture will drop to absolute zero, 459 degrees below zero. The last drop of water at the bottom of the ocean will be frozen, the last trace of air will be liquefied and lie in pools on the surface of the planet; all vegetable life will have disappeared, and with it the last trace of animal life, including man.

Then the earth, a dark, frozen world, will continue to rush on in space for endless ages until in some celestial cataclysm it encounters another body also flying through space. This chance neighboring with other matter, if a close meeting or actual collision, will cause such tremendous electronic and atomic ex-

citation in the earth as to reduce all its structures to simplest gaseous forms again. In other words, if the contiguity of the other heavenly body be close or an actual collision takes place, the earth will explode. All the matter of which the earth is composed will return to the form of a nebula, composed probably of hydrogen and other gases. Such celestial catastrophies as this are a matter of frequent observation in what is known as the *novae*.

Of course, the possibility exists that the earth may meet with this catastrophe before it has cooled to the point of lifeless refrigeration; but in view of the distribution of matter in space, the relative sizes of the masses of matter, and the celestial motions and velocities, the probability of such a collision is so remote that it is not likely to happen for many hundreds of millions of years.

This, then, is a brief outline of some of the important points in the life history of a world. But when we think of a star should we think of a single unit? Our sun is but an ordinary star, a very modest star. A great many of the stars are thousands and millions of times larger and a great many of them are also many thousands of times brighter. Our sun is a little old three-quarters-worn-out star, relatively so small that it is all but utterly insignificant even in the particular galaxy in which it happens to be located. Yet this relatively insignificant sun has a large family of planets and asteroids of its own. There are eight of these major planets with their various satellites, also a very large number of planetoids, little

toy worlds, some measuring only a few miles in diameter, others measuring up to hundreds and thousands of miles. Nearly one thousand of these larger planetoids or asteroids have been found, but it is also known that in this asteroid group there are smaller bodies running into many thousands. A celebrated Belgian astronomer has calculated that there are not less than 50,000 of these small asteroids swinging in their own individual orbits around the sun.

Let us visualize, then, the solar system; the central sun with its planets; Mercury, sailing in an orbit relatively close; then the planet Venus; next the earth with one moon; then the planet Mars, with two moon; next the Asteroids, nearly a thousand large enough to be individually discovered; next Jupiter, with its nine moons; then Saturn with its nine moon and its wonderful rings; beyond Saturn, Uranus and Neptune, the farthest known planets of the system. Visualize all these planets, spinning on their axes, swinging in their orbits around the central sun, all the moons at the same time circling around their mother planets, and the thousands of asteroids in their very eccentric orbits so interlocked with them that the whole mass are bound together, all moving in perfectly beautiful harmony. Surely, a very complicated system for so insignificant a sun to have.

What of the other millions and millions of stars in our own star system? Do they also have their planets and satellites? Reason says that undoubtedly they have. To assume that our own sun is the only one out of these billions of stars to have satellite

planets, and habitable worlds such as ours, would be utterly absurd. The mathematical law of probability that such bodies are found with other suns is so entirely one-sidedly in favor of the presence of planets with other stars as to approximate absolute certainty. When we remind ourselves that chemical analysis of the stars by means of the spectroscope shows exactly the same elements as are found on the sun and earth, according to the evolutionary ages of the stars examined, it is clear that on the accompanying planets which have developed to the point that the earth has developed the same elements and chemical combinations must be present.

The existence of planets with other stars cannot be directly proven by observation because the largest planets would not be visible at the distance of even the closest of the stars. For instance, if we could journey only to the very closest star, Alpha Centauri, and through the most powerful telescope we now have on the earth, look back toward our solar system, the mighty planet Jupiter would be entirely invisible and could not be photographed. The only thing we could see at all would be the sun, perceived only as a faint star. The eight large planets and the thousands of other bodies that make up the solar system would be far beyond the point of visibility.

Just so when we turn our telescope from any post of observation on earth toward even the closest of the stars we cannot see, or expect to see, any trace whatever of planetary systems such as encircle the

sun. But the scientific laws indicate that such planetary systems do exist.

And here the question will arise, what of life upon those planets? Whatever we may say on the question must be based on the use of philosophy, or sound reasoning upon the known facts that apply. Obviously, no observation is possible. But we do know that the chemistry of the universe is identical with the chemistry of the solar system and the earth. Since natural laws are infinite, eternal and unchangeable, it follows as a necessary conclusion that, wherever heavenly bodies have advanced to that point of similarity to the earth in the elements of which they are composed and in their chemical organization that life *can* come into being, life *must* come into being. We may therefore safely accept the idea that wherever planets like the earth encircle stars like the sun, there life has come into existence; and that wherever sufficient time has elapsed, this life will take on various forms as it has done upon the earth.

In order to get a clearer understanding and appreciation of our position and relative importance among the other works of the Creator, it is necessary that we next consider the place of our solar system in the galaxy. The number of stars, some visible to the eye, others through our great telescopes, and still others which can only be photographed, but all belonging to one great star system in which we are located, is so great that it runs at least into the billions. The charting of the stars of the universe on the maps of the astronomers and the measuring

PLATE II. A star cloud in Sagittarius, showing the myriads of stars in the direction of the Milky Way. Photographed by Mr. E. E. Barnard.

of star distances have now reached such a point that the shape or configuration and approximate size of our starry universe can be platted with a considerable degree of accuracy. Here is an evidence of the perfection to which the science of astronomy has already been pushed by the ingenuity of man.

The details of the work of platting the design of the universe need not be fully set forth here. For thirty years the starry heavens have been consistently and systematically photographed and great advancement accomplished in the matter of determining the distances of the stars from us in the various directions. Today it is definitely known that our star system, comprising all the stars that the eye can see, and billions more too far away for ocular vision, are arranged somewhat in the form of a wheel, the thickness of the wheel at the hub being approximately one-third the diameter of the entire system. Our solar system is located within this wheel. When we look into the heavens even the unaided eye can see that the number of stars in the direction of the rim of the wheel is very great in comparison with the number in the directions at right angles to the plane of the rim. The eye can clearly see the vast number of stars whose light blends together and forms what we call the Milky Way. For the Milky Way is nothing more or less than the light from myriads of stars lying at various distances in the general direction of the rim of our wheel-shaped system.

The solar system, which means our sun's system, is not located at the center of the wheel, but is ap-

proximately one-third the distance from the hub to the rim; it is not in a direct line in the center from the hub to the rim, but lies at a considerable distance to one side.

If we could take a position off in space sufficiently far away and look back toward our universe, and see it edge on, it would probably present much the same appearance as the spiral system H V 19 in the constellation of Andromeda, for it happens to be oriented in space with the edge exactly toward us. Photograph of this system is shown in plate No. III.

Let us visualize, then, if we can, what we amount to in our own star system. Our own sun, approximately one million times as large as the earth, is but an insignificant speck of light in this great star system. The entire sun and its solar system could be taken out of the immense wheel and it would never be missed. As for the earth, it is utterly insignificant, not even seeable or its existence known at the distance of the nearest star. In the great wheel system of the universe the sun is but as a grain of sand, and the planets which encircle the sun are invisible nonentities that simply do not count at all, hangers-on in an immensely greater system. And accompanying the other billions of stars, many of them millions of times as large as our sun, there are doubtless other billions of planets more or less similar to our own. But all are invisible and relatively insignificant.

View, then, that immense system of stars, all spinning on their axes, with their planets circling about them, and each star with its family of planets

PLATE III. Spiral Nebula H V 19 Andromeda, as photographed at Mount Wilson Observatory. The edge of the star system is toward us.

following its own great orbit in the galaxy; the entire system probably in rotation around a central point. But so immense is the universe of stars, so inconceivably great are the distances the stars must travel in one revolution around the central axis, that many thousands of years are required to perform one cycle.

This is our own little family of stars, all very far away, yet all so relatively close to us as to be bound together by common ties into one system. But is that all that the heavens reveal? Modern astronomy, by the aid of wonderful telescopes and exceedingly sensitive photographic plates, has revealed many other systems of stars entirely separate from and outside of our own. These other star systems, or universes of stars, assume varying configurations. Some are known as clusters, while others are very clearly seen to be arranged in spiral formation. In the direction of the constellation of Hercules, but far, far beyond those stars which mark the constellation, there is such a cluster. If you know exactly where to look, and the sky is very clear, an extremely keen eye may dimly discern a tiny patch of light. Turn a good telescope on this spot and what has apparently been a very dim star is seen to be a cluster of stars. Point one of the great astronomical telescopes at the object, use in place of the eye a sensitive photographic plate, and give it an exposure of several hours, and by means of the photograph you discover the existence of the immense star system which is catalogued as

Messier 13, Hercules. A photograph of this cluster is shown in Plate IV.

This immense star system numbers at least one hundred thousand suns, and most of those revealed are far larger than our sun. In the photograph they seem to be bunched closely together, but this is apparent and not real, and is owing to the great distance at which the system lies. In the very heart of the cluster the closest of the stars are many millions of miles apart. Doubtless these stars also have planets encircling them, and the planets their moons, the same as in our solar system.

And here is a bit of interesting fact pertaining to the placing of these star clusters in space. I have mentioned that our star system is arranged in the form of a wheel. There are eighty-six of these star clusters now known, and the peculiar fact is that exactly one-half of these eighty-six are found on one side of our star system, and the other forty-three on the other side of the wheel—more or less evenly distributed toward the poles of our galaxy.

How far away is this star cluster, Messier 13? To name the distance in miles would be like naming the distance to the moon in inches. We must devise other means to place the facts before the mind so that to some extent they can be grasped. For this purpose we use the speed of light.

Light shoots through space at the inconceivable velocity of 186,330 miles per second. The light from the sun reaches the earth in a little over eight minutes. Therefore if we are observing something that

PLATE IV. Star cluster M 13 Hercules, photographed at Mount Wilson Observatory. Exposure 11 hours.

is happening on the sun we are seeing it, not as it is at the moment of observation, but as it actually was eight minutes before. When we photograph this cluster in Hercules, at what date did the light which affects the photographic plate leave the stars? How long has the light been in getting here across the intervening distance?

When the Pharaohs of Egypt were building the pyramids the light rays from Messier 13 had almost reached the earth, relatively speaking, for this cluster lies so far away that light requires no less than thirty-seven thousand years to traverse the space. Yet, as stellar distances go, this is relatively close to us, and many of the star clusters lie at distances from one hundred thousand to two hundred thousand light years away.

Before leaving the subject of astronomy we must consider the spiral systems, because they present the most magnificent view of all. Our own starry universe is probably arranged in the form of a spiral; though the brightness of our star system, it is known, is dim as compared with many of the great spiral systems. These immense systems consist of stars that are drawn together by the power of gravitation and held in the spiral configuration or grouping by the centrifugal and centripetal forces in control. These immense systems are in rotation around their central axes, and although they are of such prodigious extent that thousands of years are required for one rotation, still the period of rotation of several of the spiral systems has been ascertained. One

of the spiral systems is known to perform one turnover in forty-five thousand years, another in eighty-five thousand years.

The great spiral in Andromeda may be taken as an example typical of the spiral systems. Here is a vast system of stars or suns so prodigious in number, so extensive in space, as to stagger our very imagination. In this panorama (a photograph of which is shown in Plate V) you are looking upon what many astronomers consider to be the sublimest spectacle ever beheld by the eye of man. Here on display are the works of the Creator at the height of their magnificence, sublimity and majestic grandeur. This system is so vast in extent that it is easy to take a large photograph of the spiral, even though it lies so far away that its light requires nearly 1,000,000 years to come to us. In other words, the photograph of this system (Plate V) shows it as it was nearly a million years ago. There is absolutely no way by which we can see this system as it is today.

If a man thinks he is somebody, or is quite inclined to feel important, let him come under the spell, ever so little, of what such spiral systems mean. Perhaps then he can be made to realize that he is but a poor, insignificant microbe on a tiny grain of dust, which itself means nothing even in the single star system in which it is located; and that this system itself is but a relatively unimportant one out of the hundreds of thousands of such systems that are known to exist.

PLATE V. The Great Spiral System in Andromeda. The sublimest spectacle ever beheld by the eye of man.

The Lick Observatory in California, which is making a catalog of the spirals, expects to list over seven hundred thousand of these star systems.

The great spiral systems that the telescope reveals are, in my opinion, the most awe-inspiring spectacle open to men to behold. But on beyond the spirals there is something more—still greater, too great for the human mind; for out there is that Creative Force which produced the stars and the planets, which brought them into relationship with each other, which has organized all the starry systems in absolute accord with specific laws. For the universe of the universes is an orderly cosmos. Law and order prevail everywhere. Here is intelligence of an order and magnitude that the human mind simply cannot comprehend.

The spiral universes, then, in connection with the star clusters, the planetary nebulae and the nebulae of other configurations, as well as the dark nebulae that are now known, give us ample food for thought. The immensity of these things, indeed, is so staggering that the human mind is almost completely baffled by the super-meaning of it all. But we do know this: The prodigious magnitude of the heavens, the exceeding complexity of organization, the perfect order that prevails, the absolute compliance with natural laws that can be seen everywhere, the perfection and beauty always observable, reveal clearly to our minds that there is something going on here so charged with meaning that we simply cannot begin to comprehend it. Here is Supreme Intelligence

and Power on display. All we can do is to wonder and admire, and learn an iota or two of its great significance. We can never comprehend it. But in it all and through it all we can detect, beyond peradventure, law, order, cosmos, Energy.

CHAPTER III

THE PHYSICIST SPEAKS

Law, Order, Cosmos, God

In the beginning, God.

Speaking strictly in the language of the physicist—in the beginning, Energy.

All realities that are found to exist throughout the cosmos, all conceptions of which the human mind is capable, fall within the circumference of the two inclusive words, energy and matter; and now some late scientific discoveries in the field of physics even indicate that the two are one and matter's various forms are only somewhat different manifestations of energy.

Energy is power; the capacity to do work; the ability to overcome resistance; the supply of force that brings about change.

Matter comprises all the stuff of which the material cosmos is composed. It is those forms of physical manifestation by means of which we come in contact with energy and reality. It occupies space, and is heavy or light of weight. It can be analyzed into the atoms, the atomic combinations, the gases, the liquids, the solids by which all realities on the earth and in the starry heavens take to themselves a

body and are made manifest. All matter seems to be physical manifestations of energy, and the storehouse of energy. Matter is never anywhere present where energy is absent; and, without the expenditure or the release of energy, no change in the status of matter can be made.

The advance of scientific knowledge in the realm of physics led long ago to a generalized statement of the above principle expressed in the terms of the law of Conservation of Matter. This conception found it apparently true that matter could not be destroyed. Coal could be burned, rocks might be melted and gasified, all sorts of chemical combinations and changes might be induced, but the law of Conservation as conceived of Matter declared that the sum total of the material products that remained after the change are exactly equal to the original mass.

About the same time the principle of Conservation was found to apply in the field of energy. Under the law of Conservation of Energy the total amount of energy in the world or universe never varies and must forever remain the same. The energy units stored in a ton of coal when burned under the boiler were transformed into heat units in the combustion chamber, into pressure units in the steam dome, into mechanical units and units of energy of motion in the engine and the machinery driven by the engine; into electrical units in the generator driven by the same power; into heat and light units in the lamps lighted by these electrical units; or again into power

and pressure in the electric motor, and so on. Energy could be transformed and transferred back and forth practically at will. But the sum total of all its forms forever remained the same.

Today physical science is taking another step forward. We are finding that these laws of conservation are correct only within certain limits. They are like Euclidean Geometry, right in principle, but not exactly applicable to the existing realities; and just as Einstein called attention to the slight discrepancy between the abstract principle and its concrete applications in the cosmos and corrected the mathematical formula to conform to the realities, so we are today at work correcting this older formulation of the principle of conservation.

We are finding that the older law of Conservation of Energy and the older law of Conservation of Matter merge into one law of Conservation of Energy and Matter. This law, which is a more accurate statement of the absolute truth, and apparently the final one, runs thus: (1) *The sum total of all the energy and all the matter in existence forever remains the same;* (2) energy and matter may each change its classification and be transformed from one to the other; (3) an exact quantitative value ratio exists between energy units and material units; (4) that relationship is apparently 34,000,000 horsepower hours per gram of matter.

For we are finding now, as a result of the discoveries made possible by the development in radioactivity, that matter sometimes does cease to exist as

matter, and in so doing the energy formerly stored up in it is released for other uses. In the laboratory we can cause matter to disappear and slip away out of existence; and thus provide ourselves with a new supply of energy through the destruction of that matter. But always the absolute quantitative relationship between energy units and material units seems to remain undisturbed.

Nor does the new law of conservation throw the slightest discredit on the old. The law of Conservation of Energy and the law of Conservation of Matter still apply, still hold good, within those fields of investigation which engaged the physicist, the chemist and the biologist prior to the days of radioactivity. But the discovery of radium and radioactivity has revealed the existence of a vast new domain of fact whose boundaries extend beyond those in which scientists were formerly content to search. It is in the field of radioactivity that the blending of the laws of conservation occurs; and only where radioactivity is present does the old law of Conservation of Energy and the old law of Conservation of Matter cease to apply with exactness.

The one basic law covering all instances of conservation is the big general law of Conservation of Energy and Matter. It may be likened to the Constitution of the United States; in turn, the law of Conservation of Energy and the law of Conservation of Matter might be likened to statutes of two different sovereign states, each legal and binding in its field, without any conflict of jurisdiction between

them; yet both connected and related and sanctioned by the higher law. The higher law supplies the parentage from which they are born; it imparts to them its own reality, and from it they receive their power. But as the individual statute does not suffer any loss of dignity or power, by reason of the limitations of its application, just so the old laws of conservation still retain their dignity and power and absoluteness within those fields which we now know mark their limits.

And physical science has already penetrated far enough to ascertain what the relation is between the energy units and material units. It has been found that any material substance, whether it be an individual one of the so-called original elements, calcium, iron, hydrogen, copper, etc., or any combination of these elements such as water, air, rock, etc., in ceasing to exist as matter liberates energy to the extent of 34,000,000 horsepower hours per gram. Conversely, this means that every gram of matter in the universe, in the process of attaining its present material form, has required the expenditure of 34,000,000 horsepower of energy for one hour.

This is the so-called "energy of the atom." In endeavoring to comprehend this marvelous fact, and in a vague attempt to compute what this means in terms of the tremendous volume of matter that exists in the universe, we are staggered at the prodigious amounts of energy that surround us on every hand.

Here, then, is the starting point for our thought.

Here is the very beginning. Energy and its material equivalent are infinite, eternal and unchangeable; transformable, but not changeable.

In our earlier school days we were taught that all matter consisted of some sixty-six different original *elements*. These were considered to be absolutely distinct and different substances having no relation to each other, the primordial raw materials of which the world was composed. Since that day new elementary forms of matter have been found from time to time, and today the catalog contains eighty-nine so-called primary elements that have already been discovered.

And in recent years, by delving into the question of the atomic structure of these primary elements, some very wonderful truths have been revealed. It has been found that the various elements contain electrons differing in number in their atomic structures. Recent discoveries therefore pertaining to the structure of the atom itself and its energy contents must next be considered.

In the structure of the atom two energy entities are found, which may probably be best described for the general reader as static charges of negative and positive electricity. The negative electrical energy content is localized in the electron, while the positive electrical energy content is localized in a nucleus. These parts are not in physical contact, but rather at great relative distance from each other.

The negative contents, the electrons, like static negative electrical charges, oppose each other; they

repel; they try to get away from each other as far as possible. The positive nuclei also repel each other and try to separate, just as two balls carrying positive electrical charges repel each other and try to separate. But there steps in another factor, an equally powerful *attraction* between the positive nucleus and the negative electrons. The nucleus attracts every electron in the atom, and it is this attractive force between the nucleus and the electrons which prevents the various electrons which may be within the atom from flying apart and putting greater distance between themselves. Conversely, it is the attraction of the negative electrons that holds the positive charges in the nucleus.

These electrons within the atom are in exceedingly rapid motion, whirling around the central nucleus as the planets and asteroids in the solar system whirl in orbits around the sun; and the relative size of the electrons and their orbits of circulation around the central nucleus are believed to be somewhat on the order of the size and distance of the planets in the solar system. Thus physical science, in delving so far into these exceedingly minute entities, has brought forth the expression, "the astronomy of the atom."

An atom of many electrons, or a molecule of many atoms, might be likened to a swarm of bees in the air; a unit of many parts, all in rapid motion, possessing various material characteristics, and capable of manifesting energy in a number of ways.

Here, then, is the very beginning, the first, the

minutest manifestation of energy and matter of which we have any knowledge. Here are attraction and repulsion; energy of motion; conceivably energy of momentum, centrifugal force and centripetal force; and, as will be shown later, energy capable of performing work in various ways.

Right at this point it should be remarked that these energy contents of the atom, the negative electrons and the positive nucleus, now appear to be absolutely identical in the atoms of different elements, no matter what the past history of those atoms. The organization of the parts is different in the atoms of different elements, but the parts the same. No matter whether the atom which you are dealing with be one of iron, hydrogen or any other atom, the indication in all experiments up to date is that the electrons of these atoms are exactly similar. And the same thing appears to be true of the nuclei of the atoms. This appears to be the first step taken in the synthesis, the manufacture, the evolution of matter.

This is a Fundamental, and its Importance Cannot Be Overestimated.

Another point that should be made here, early in our study, for use later on, is the matter of geometrical arrangement, or configuration, that has also been found to enter into the structure of atoms and matter. As was pointed out above, the electrons are opposed to each other and can be held together only by reason of the attractive force of the nucleus. The

important fact to note right here is that the method by which these electrons are held by a fast grip is a geometric arrangement or structural configuration, the particular arrangement in any given case depending upon the numbers of units in the electron system and in the system of the nucleus.

Here are perfect system, geometric arrangement, mathematical exactness, absolute law. If we had a microscope that would enable us to see the structural arrangement one by one of all the atoms, beginning with hydrogen, the simplest atom of all for it consists of only two parts, a simple nucleus and a single electron, and leading up to uranium complex of nucleus and with ninety-two units in its outer electron system, and observe all these systems in motion, the electrons flying at terrific speed around their central nuclei, all the different atoms with their varying complexity of structure like so many different stellar systems in the heavens, we would be struck with amazement at it all. And yet our study has progressed no further than the consideration of the tiny atom which is the raw material of all later and more elaborate construction.

It is very important that the reader gets this information clearly. In the very beginning, within the atom, the smallest material structure, we find *organization according to exact mathematics.* Energy is here at work in accordance with unchanging, unchangeable law. Here is *accomplishment.* Here is law; order; a cosmos; not chaos; here are the evidences—yes, the positive proofs—of what

we call *intelligence;* and of so high a quality that we cannot comprehend it.

It is at first hard for us to conceive of intelligence as existing and identifiably present apart from animate things. We have gotten so deeply in the habit of applying the word only to mankind and the balance of the animal kingdom—and in connection with our different notions of some kind of an anthropomorphic God—that it is at first difficult for us to conceive of the presence of intelligence in an atom of iron, a molecule of water, or a bit of rock. Yet we do now positively know that in every bit of matter in the universe orderly laws are operative which, for mathematical exactness, perfection of application and sublimity of conception never cease to be a source of wonder to the most learned scientist.

Perhaps intelligence is not the exact word to use to account for the cosmical order and law that we find here, but I know no better. Perfect order and law are there, on a scale amply sufficient to suggest and typify the Supreme Intelligence, the Guiding Energy that is back of all things. We may call that presence the presence of God.

We must, therefore, keep on going back of the molecule of matter, back of the atom, back of the electron, to the Supreme Intelligence, the Great First Cause. In the beginning, Energy; in the beginning, God.

I have stated that the electron is essentially a negative electrical charge. We can probably best visualize this by thinking of the electron as the smallest pos-

sible unit of static electricity. Electrons are frequently discharged, shot out, from some elements, and then they seek to attach themselves to other atoms. This is radioactivity. If we cause a steady stream of these electrons to flow in one direction, we have a current of electricity. To give an idea of the size of this unit of electricity I can do no better than to quote from Millikan:[1]

> Perhaps these numbers (representing the value of the electron) have little significance to the general reader who is familiar with no electrical units save those in which his monthly light bills are rendered. If these latter seem excessive, it may be cheering to reflect that the number of electrons contained in the quantity of electricity which courses every second through a common sixteen-candle-power electric-lamp filament, and for which we pay 1/100,000 of 1 cent, is so large that if all the two and one-half million inhabitants of Chicago were to begin to count out these electrons and were to keep on counting them out each at the rate of two a second, and if no one of them were ever to eat, sleep, or die, it would take them just twenty thousand years to finish the task. So the consumer gets considerable for his money after all.

Visualizing the structure of the atom we found a relatively large positive central nucleus, comparing

1 Robert A. Millikan, *The Electron.*

with the sun in our solar system, and small negative electrons comparing with the planets. Of these two parts the mass or the space occupied by the positive nucleus seems always to be very much greater than the mass of the electron, yet very small as compared to the mass of the entire system.

Millikan ascertained the relative sizes of the electron and the nucleus. The mass of the positive nucleus is on the order of 1845 times the mass of the electron. In the case of the atom of hydrogen, which is the simplest known, there is a singular nucleus and a single electron to form the system. The other so-called chemical elements exhibit a more complex construction, some having complicated nuclei and large numbers of electrons in their planetary systems, with increasing complexity of configuration and new energy manifestations not found in the simpler atoms.

It has been stated that the different chemical elements, though made up of the same positive and negative unit particles, contain different numbers of these particles in each case. This is how they come to have what is known as atomic number. The atomic number means the number of electrons that are found in an atom external to its central nucleus. To make plain the interesting and pertinent facts of atomic number and atomic weight the following table is given:

Atomic Number	Element	Symbol	Atomic Weight
1	Hydrogen	H	1.008
2	Helium	He	4.
3	Lithium	Li	6.94
4	Glucinum	Gl	9.1
5	Boron	B	11.
6	Carbon	C	12.
7	Nitrogen	N	14.01
8	Oxygen	O	16.
9	Flourine	F	19.
10	Neon	Ne	20.22
11	Sodium	Na	23.
12	Magnesium	Mg	24.32
13	Aluminum	Al	27.1
14	Silicon	Si	28.3
15	Phosphorus	P	31.04
16	Sulphur	S	32.06
17	Chlorine	Cl	35.46
18	Argon	A	39.88
19	Potassium	K	39.10
20	Calcium	Ca	40.09
21	Scandium	Sc	44.1
22	Titanium	Ti	48.1
23	Vanadium	V	51.
24	Chromium	Cr	52.
25	Manganese	Mn	54.93
26	Iron	Fe	55.84
27	Cobalt	Co	58.97
28	Nickel	Ni	58.68
29	Copper	Cu	63.57
30	Zinc	Zn	65.37
31	Gallium	Ga	69.9
32	Germanium	Ge	72.5
33	Arsenic	As	74.96
34	Selenium	Se	79.2
35	Bromine	Br	79.92
36	Krypton	Kr	82.92
37	Rubidium	Rh	85.45
38	Strontium	Sr	87.63
39	Yttrium	Y	88.7

Atomic Number	Element	Symbol	Atomic Weight
40	Zirconium	Zr	90.6
41	Columbium	Cb	93.1
42	Molybdenum	Mo	96.0
43	Masurium	—	
44	Ruthenium	Ru	101.7
45	Rhodium	Rh	102.9
46	Palladium	Pd	106.7
47	Silver	Ag	107.88
48	Cadmium	Cd	112.40
49	Indium	In	114.8
50	Tin	Sn	118.7
51	Antimony	Sb	120.2
52	Tellurium	Te	127.5
53	Iodine	I	126.92
54	Xenon	X	130.2
55	Caesium	Cs	132.81
56	Barium	Ba	137.37
57	Lanthanum	La	139.
58	Cerium	Ce	140.25
59	Praseodymium	Pr	140.9
60	Neodymium	Nd	144.3
61	Ilinium	—	
62	Samarium	Sa	150.4
63	Europium	Eu	152.
64	Gadolinium	Ga	157.3
65	Terbium	Tb	159.2
66	Dysprosium	Ds	162.5
67	Holmium	Ho	163.5
68	Erbium	Er	167.7
69	Thulium	Tu	168.5
70	Ytterbium	Yb	173.5
71	Lutecium	Lu	175.
72	Hafnium	Hf	
73	Tantalum	Ta	181.5
74	Tungsten	W	184.
75	Rhenium	—	
76	Osmium	Os	190.9
77	Iridium	Ir	193.1
78	Platinum	Pt	195.2

Atomic Number	Element	Symbol	Atomic Weight
79	Gold	Au	197.2
80	Mercury	Hg	200.6
81	Thallium	Tl	204.
82	Lead	Pb	207.20
83	Bismuth	Bi	208.
84	Polonium	Po	———
85	———	—	———
86	Niton	Nt	222.4
87	———	—	———
88	Radium	Ra	226.
89	Actinium	Ac	———
90	Thorium	Th	232.4
91	Uranium XII	UrXII	———
92	Uranium	Ur	238.2

The table shows the known elements, their symbols, their atomic *numbers* and their atomic weights. The atomic number is based upon the free external electrons. Inasmuch as many of the elements have complex nuclei, the structures are more complex than the atomic numbers indicate, and their complexity and energy and material contents are better shown by the atomic *weights*.

For instance, hydrogen, with atomic number 1, contains one negative planetary electron. Carbon contains 6 negative electrons, oxygen 8, iron 26, radium 88, and uranium, one of the most complicated atomic systems we now know, contains 92 electrons in its planetary system.

But notice now the atomic *weights*. Hydrogen, with one electron, has atomic weight 1.008; helium, with 2 electrons, has atomic weight 4; carbon, with 6 electrons, atomic weight 12; oxygen, 8 external

electrons, atomic weight 16. In the more complex atoms the nuclei themselves become complex and the mathematical law of balance between the nucleus and the external system also becomes complex. The atomic *weight* includes all parts of the atom.

Here is an important point: The energy contents of the atom depend upon the character of the nucleus as well as that of the external part. Therefore, for the consideration of its chemical affinity, biological influence, etc., the atomic *weight* has to be used.

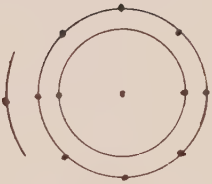
In the elements having eighty-eight or more free electrons in their planetary system the structures become so complex as to pass beyond the point of stable equilibrium, and electrons are being continually thrown off and lost. This act of departure of the electrons is known as radioactivity.

The human body is made up of many of these elements. Hydrogen (atomic weight 1.008), Carbon (12), Nitrogen (14.01), Oxygen (16), Phosphorus (31), Sulphur (32.06) and others, but the greatest volume consists of oxygen and hydrogen forming water. Each molecule of the water in our bodies consists of two atoms of hydrogen and one atom of oxygen combined. The two atoms of hydrogen will have the two positive nuclei, and each its encircling negative electron. In the union there is also the oxygen atom with its positive nucleus and eight negative electrons, all in rapid motion and displaying various forms of energy. Along with these there is an infinite complexity arising from the many

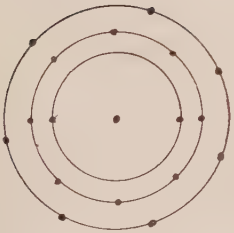
Hydrogen

Carbon

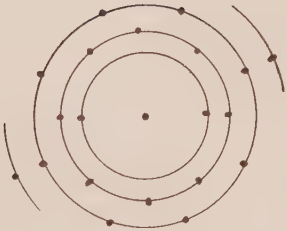
Oxygen



Sodium



Chlorine



Calcium

PLATE VI. Drawings to suggest the number and arrangement of the electrons in atoms. The exact configurations cannot be shown.

other and more complex atoms also present in the human body.

But there steps in an attractive force between the elements, technically known as chemical affinity, which sees to it that the energy of each atom is *expended in a new way* when two or more of them are brought together. Such union means a re-ordering of the old energy manifestations and often the birth of new forms of energy. Think now of that molecule of water in the human body, the new physical manifestation, water, that is introduced when the two are combined, so different from either hydrogen or oxygen; think also of those attractive forces in the atoms, the repellant forces in the atoms, the exceedingly rapid vibration or motions of the electrons, the chemical affinity at work, the many other elements present and occupied with their own concerns, their different energies and physical characteristics, their actions on each other. How infinite the complexity of it all. "What a piece of work is man!"

From the very complex atomic structures of the many other primary chemical elements found in the body, the varying quantities of these elements and their compounds organized into the brain and our various other organs, the innumerable possible combinations of these elements and the various energies therein contained, we get a glimpse *of what the human body is capable*—AND WHAT IT MUST PRODUCE.

It will be remembered that the physical properties

of the different elements are but the outcome of the different designs, or configurations, the difference of plans, upon which the Great Architect has made up the different combinations. These peculiarly constructed atoms are the bricks of various forms from which masses of the elements are built up, but all the various bricks are made of the same kind of clay.

And just as the original clay, energy, when put into bricks of various atomic forms and sizes, make the eighty-nine known elements, so these elementary bricks may be combined into innumerable larger structures, different again in plan, and still more complicated in configuration—material, vegetable, animal; and just as the physical characteristics change under combination, so the energy manifestations change; and as the physical characters become more increasingly numerous in the mineral, the vegetable and the animal world, so must the energy manifestations in the vegetable and the animal necessarily become increasingly numerous and varied.

Here, then, we may state a fundamental fact of transcendent importance: *The characters of the so-called primary elements depend upon their electronic and nuclear construction; upon the configuration or arrangement of the particles of which the atoms are composed; and upon the energy manifestations peculiar to each atom.*

Later on in this book I shall present some further statements concerning facts parallel to these which the reader who has not studied along scientific lines may find hard to accept. They may seem too wonder-

ful to be true. But nothing that will be presented is more wonderful intrinsically than this anatomy of the atom, or, for that matter, the facts of daily occurrence in ourselves and in the world and the universe about us.

After all, what is it that makes any fact wonderful? It is all a matter of our lack of familiarity with that fact. To the scientist who has delved deep into physics the statements here made are but A B C. To him many of these facts are old and familiar, and therefore no more wonderful than the simple facts of nature are to us. Things seem wonderful to us when they are new to our minds. But they cease to be wonderful as soon as we comprehend them and familiarize ourselves with them.

The idea that the constituents of an atom of iron, an atom of carbon or an atom of radium, are in the last analysis identical, will be a new and wonderful thought to many minds. Our mental habits are such that many of us will be slow to admit what physical science has proved. In everyday language, it will seem "too strange to be true." But what could be more strange than the fact of our own existence? Or the fact of mentality arising out of the exceedingly complex organic structure of the human brain? Or the biological processes that produce the striking beauty of the tulip or the rose, and insure their reproduction year after year? Or the divine alchemy which transforms the energy of the lowly worm into beautiful song in the voice of a bird? Although

these things are very wonderful, do we refuse to admit their truth?

The point which I wish to make emphatic here is that we must not bar the door against other marvelous facts which we have not heretofore known or which we cannot at first understand. We *must* admit facts for which the evidence is good, even though they be "too strange to be true." If we refuse to have anything to do with them we are then not honest with ourselves, not reasonable beings. How absurd it is, when stated plainly, to take the stand that what we have not heretofore believed cannot be true! Compared with what is to be known, that which we do know is small indeed. The knowable but unknown is almost infinite in comparison with what we do now know. Recall the line from Shakespeare: "There are more things in Heaven and earth, Horatio, than are dreamed of in your philosophy."

Radioactivity

The metal radium discovered and made famous by Madame Curie was instrumental in bringing about a great advance in knowledge. So much has been written about it that it is now more or less well known. The wonderful thing about radium is, or was—for it has now ceased to be wonderful—the fact that minute particles of itself shoot off from it in all directions.

Sir Ernest Rutherford, F. R. S., showed that the alpha rays that are emitted by radium, and all radio-

active substances, are really atoms of helium. This explosive rejection of an atom of helium from a bit of radium is accompanied by the release of a considerable amount of energy. Rutherford[2] says: "In order to produce alpha, beta, or gamma rays of equal energy to those emitted by radioactive substances, potential differences of about 2,000,000 volts applied through a vacuum tube would be necessary."

This means, then, that in accomplishing the synthesis required to produce radium, tremendous quantities of energy have been expended. Here, again, we see the storage of energy in matter. As the matter crumbles and is reduced to simpler forms swarms of that energy are again released. The production of radium is therefore a very difficult and a very expensive process. One gram of radium, about a thimble full, and equal to 1/28 of an ounce, is worth at least $100,000. In 1921 Madame Curie was presented with one gram of radium by the women of America. To produce this amount of radium fifty tons of carnotite ore were necessary, and the process required the consumption of 1500 tons of coal.

In all these highly complicated elements there is a tendency to drop back to simpler forms. This disintegration takes place in a systematic order, and, under normal conditions, time is a factor in the process. The radioactive elements have their life periods, after which they die and cease to be those

2 Sir Ernest Rutherford, *Report Smithsonian Institution, 1919.*

elements which they had previously been and are born as something else lower down the scale of complexity of structure. Putting the *genealogy of the elements* into biblical language, Mr. Edwin E. Slosson, M. S., Ph. D.,[3] expresses it thus:

> Uranium lived 5,000,000,000 years and begot Uranium XI, which lived 24.6 days and begot Uranium XII, which lived 69 seconds and begot Uranium 2, which lived 2,000,000 years and begot Ionium, which lived 200,000 years and begot Radium, which lived 1850 years and begot Niton, which lived 3.85 days and begot Radium A, which lived 3 minutes and begot Radium B, which lived 26.8 minutes and begot Radium C, which lived 19.5 minutes and begot Radium D, which lived 12 years and begot Radium E, which lived 5 days and begot Polonium, which lived 136 days and begot Lead.
>
> The figures I have given are the times when half the parent substance has gone over into the next generation. It will be seen that the chemist is even more liberal in his allowance of longevity than was Moses with the patriarchs. It appears from the above that half of the radium in any given specimen will be transformed in about 2,000 years. Half of what is left will disappear in the next 2,000 years, half of that in the next 2,000, and so on. The reader can

[3] E. E. Slosson, *Creative Chemistry.*

figure out for himself when it will all be gone. But we may say that after 100,000 years there would not be left any radium worth mentioning; or, in other words, practically all the radium now in existence is younger than the human race.

The Evolution of the Elements

A study of the facts of radioactivity reveals certain laws governing changes in the elements. The most complex elements break down into their constituent parts and form new simpler elements. In the case of those complex atoms having atomic numbers from 82 to 92, the radioactive ones, this breaking down, or radioactive disintegration, takes place with comparative rapidity. In the elements of lower atomic number, whose structures are much more stable, the disintegration under conditions found in the earth has apparently practically ceased, though undoubtedly these elements are also not immune from further disintegration. In the laboratory some of these elements of lower atomic number may be analyzed, though some cannot be disrupted by any temperature we are yet able to produce. It is only in the fiery furnaces of the suns that sufficiently high temperatures for that purpose are produced. But the possibility of disruption and the principle of disintegration involved being known, no further discussion becomes necessary here.

An important inference here is, that if the complex structure can, through a process of disintegra-

tion, descend the scale and accomplish the formation of new and less complicated elements, then by a reverse process of integration more complex atomic structures can be built up out of the simpler. In radioactivity we have a downward evolution of the elements. By the reverse process we would have an upward evolution of the elements.

To observe the upward evolution of the elements in actual operation we must turn to astronomy and spectroscopy. The point of study is in the gaseous nebulae and the hottest of the stars. In them the spectroscope reveals the presence of a substance that is as yet unknown, but apparently a form of matter or energy in a still simpler state than in the hydrogen atom. It has been suggested that this is possibly ether particles with energy charges. Here is the birthplace of all matter. These unknown lines in the spectra of the hottest stars or suns are of such a character that they cause us to suspect that hydrogen, the simplest of the elements known today, is about to be developed. In these stars no other elements are found. In them we have therefore the starting point in the evolution of the elements.

Take now one of the next cooler stars, and the presence of hydrogen gas (atomic weight 1.008) in large volume is clearly shown. But here a new element is found, the gas helium, atomic weight 4. In all the hottest stars the spectra show the presence of nothing but gases; and the hotter the star the fewer are the gases, and the simpler are their atomic structures.

In the next stars lower down in the scale of temperature, hydrogen and helium are still present, but also carbon (12), nitrogen (14.01) and oxygen (16); and new lines are present which create a suspicion that metals will follow soon, yet the spectra are not the ordinary spectra of the metals. They are similar to the spectra of metals heated to terrifically high temperatures by means of electric sparks of hundreds of thousands of volts in vacuo.

In the next cooler stars the metals and other minerals of which we had formerly only a suspicion that they were on the way are now clearly shown to be present: magnesium (24.32), silicon (28.3), calcium (40.09), iron (55.84), stronium (87.63), and others. In these spectra again there are also suspicious new lines suggesting that still more new elements are yet to be developed which would be clearly revealed if the star were a little cooler. Examination of stars next lower in the scale of temperature shows these new elements actually present.

Note the rising atomic weight, which means an increase of complexity of the atomic structure and the *storage of energy* in the atoms. The storage of energy in the atoms of the stars marks their evolutionary progress in the descending scale of star life. It is the continuation of the synthetic production of matter in its various forms. Each element is a more or less permanent and stable energy condition. It marks a step in the organization of energy units, and brings about new physical manifestation, a heavier element having properties differing from those of

the simpler elements. But as the complexity increases stability decreases, until in the radioactive elements the atoms are so unstable that they are continually breaking down and throwing off alpha, beta and gamma particles.

Thus in the "mighty furnaces of the suns," to borrow an expressive phrase from Moore, and in the cooler planets such as our earth, there are being forged by a continuous process of energy concentration all of the elements of which we have knowledge. In our own sun the process has gone far enough to show quite a large number of the known elements present. But the full spectrum of iron, for instance, is not yet shown. Iron therefore seems now in the process of development in our sun, and spectral analysis of sunlight enough millions of years from now would indicate that iron has fully arrived.

Here the reader may say, "But this is only the old rejected alchemists' theory of the transmutation of the elements." It is, and that theory *was* until recently rejected by scientific men, for it was unsupported by evidence. But today the approach to the idea is from a new angle, and the fact is supported by evidence that cannot be overthrown. Such transmutation has been produced in the laboratory over and over again.

Just as we have learned to produce, and we have produced, real diamonds by manufacturing processes, so the technique of the manufacture of gold is bound to come. No physicist would today say it is impossible. But this is not saying that it will be a

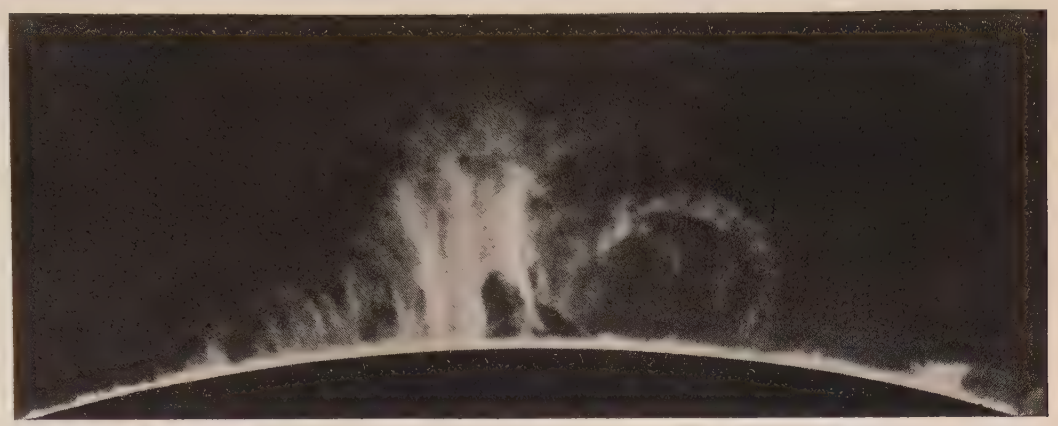


PLATE VII. "The mighty furnace of the sun," where the elements develop. These prominences, which are exceedingly hot gases, rise from the surface of the sun with explosive velocity, sometimes to heights of hundreds of thousands of miles. Yet many of the other stars are much hotter than our sun.

practical or profitable undertaking, as the work involved in the synthesis of the elements will usually prove more expensive than their value. Yet helium, formerly a very rare element and found first in the sun, we are now making in such vast quantities and at such low cost that it pays to use it for inflating our large balloons and dirigible airships.

Here, then, in the terrific temperatures of the hottest stars, temperatures we cannot maintain artificially on the earth, we have the first steps of inorganic evolution, the evolution of the elements. As the stars and worlds cool down innumerable chemical combinations take place. Thus the inorganic evolution continues. All the elementary substances with which we are familiar on the earth except those made in the laboratory, *and all their combinations* are the inevitable consequences in accordance with the unchangeable processes of natural law. Thus the dead earth was made, in complete compliance with the creative force that brought it into being; and thus the most complex atomic energy-concentrates of elements, such as radium and uranium, were made, and are even now being produced in the earth, possibly.

Therefore our mental vision should now give us a glimpse of what is going on in the interior of every bit of igneous rock and enable us to review its history. We see the atoms of possibly numerous elements, with their electrons in rapid motion; we see the electronic strains as well as the intense molecular strains that are holding all parts together so firm and solid. We see the development of its elements at

terrific temperatures millions of years ago, and the later chemical reactions between these elements as they locked themselves in each others' arms to form the solid rock. *The original energy was the creative force.*

And that creative force is the same yesterday, today and forever. In the laboratory we may make a spectrum analysis of calcium, hydrogen or any of the familiar elements. The very exact placing of the spectral lines, without the slightest deviation, except in accordance with law, is well known. Next we may turn to a study of the same element in stars so far away that their light, speeding to us with inconceivable velocity, may require a million years to reach us. Here we find the elements producing spectra exactly the same as those produced in the laboratory. In other words, the elements were exactly the same a million years ago as they are today. The laws of nature do not change, and the creative force that was operative in the stars a million years ago, and observed by us today, is exactly the same as the creative force that was working in our sun eight minutes ago, or is operative in our laboratory at this instant.

Thus within the atoms, through radioactivity, the changing conditions of matter in the suns, in the chemical combinations of the elements, we see a continual process of evolution. There is not a single stationary object in all the universe. All is in a state of flux and flow. As some one has well said, "The only permanent thing is change."

In the building up of matter, and in the changing energy manifestations that accompany this building up, we come upon more complicated structures than the simple atom that has just been described. We may have two or more positive nuclei within the structure, these nuclei being associated with a number of negative electrons, always in rapid motion. The opposing forces of the electrons, the nuclei repelling each other, and the mutual attractive forces between the nuclei and the electrons, always operating and producing motions at exceedingly rapid rate, usually balance each other and maintain a more or less stable equilibrium.

Such a complicated structure is the molecule. To increase the complexity of organization these complicated molecules sometimes associate themselves together and form still larger units. But this leads into the realm of chemistry.

What, then, are the great, all-important facts that the physicist has discovered as to the nature and constitution of matter? Study what element he may, from the simple hydrogen atom to the exceedingly complex and radioactive uranium, whether he observes the elements in his laboratory or in the sun, the stars or the remotest nebulae or spiral systems—always he finds the same law, order, cosmos, Energy, and processes of change through natural law.

CHAPTER IV

THE CHEMIST SPEAKS

Law, Order, Cosmos, God

In the previous chapter we have seen how the various elements develop in the stars and in the cooling planets. Synthetic processes there in operation, through long periods of evolution, have produced the different elements, eighty-nine of which are now known. And now, before we proceed to the next step, I ask you to consider in more detail how the electronic structures of the various elements confer upon them various and very different characteristics.

Hydrogen, atomic number 1, weight 1.008, is a gas that explodes when brought in the presence of oxygen at high temperatures or combines with oxygen in a different way to form water. Helium, atomic number 2, weight 4, is an inert gas that cannot be exploded. (Notice the great difference that the slight change in electronic structure makes.) Think of Carbon (12) and its physical characteristics and manifestations, as shown in charcoal and in the diamond; nitrogen (14.01) and its influence in promoting the development of living cells and plant growth; oxygen (16), a very lively gas that,

wherever found, is usually the active principle that gets new things done.

Think of Aluminum (27.1) and how the structural organization of the atoms produces new physical properties, a soft white, ductile metal that resists oxygen, but which passes on freely the flow of electrons known as the electric current; the electronic excitation of a different character known as heat also passes freely through the structure of the aluminum atom; Phosphorus (31.04), whose principal characteristic is that by the application of friction in the presence of oxygen it bursts into flame; and Calcium (40.09), an exceedingly white mineral that glows with intense brightness at high temperatures.

Consider Iron (55.84), its color, hardness, ductility, and the birth with it of a *new* magnetic quality; consider Nickel (58.68) and how its properties differ from those of iron, including the fact that it is only slightly magnetic; or Copper (63.57) and how it in turn differs from Nickel; and Zinc (65.37) and how it differs from the metals formerly mentioned.

On up the ladder among the more complex elements is Selenium (79.2). One of the remarkable things about Selenium is that in a peculiar way it is sensitive to light vibrations. Selenium is a conductor of electricity, but its conductivity is instantly changed when there is a change in the light rays falling upon the element. Throw a stronger beam of light on a bit of Selenium and the motions of its electrons are changed so that its electrical resistance is instantly

decreased, and the amount of the electric current—which means the number of the electrons flowing through it—will be decidedly increased.

Is it wonderful that an element should thus be so sensitive to light rays? It is only a forerunner of the sensitiveness to light rays that organic chemistry shows us in all plants, and even in animal life. For the plants also feel the presence of light rays, reach for them, and the electronic structures in their atoms and molecules and cells suffer change under the vibrations received from the sun.

Still higher in the ladder, passing by many on the way, is the element Silver (107.88); and Tungsten (184) having the peculiar power of turning an electric current into light vibrations; and Platinum (atomic number 78, weight 195.2); and next Gold (atomic number 79, weight 197.2); then Mercury (atomic number 80, weight 200.6), a metal in fluid state except when its temperature is reduced below —38 degrees F.

But it will not be necessary to go through the whole list of the elements. The point is surely very clear that a comparatively slight addition to the actual contents of the atoms of the elements brings about a new structure, and that this *new structure confers upon an atom very great difference in physical properties and characteristics. It makes it over into something else.*

All these different properties and characteristics, shown by the various elements, a few of which have been named, attach to the original elements in their

simple, single state. But these elements may be combined with each other, and they are combined in nature. And when we consider the large *number* of elements, the great *variety* of their characteristics, and the innumerable varying *quantities* with which combinations can be made, we see that the possible products and consequent physical manifestations are practically innumerable. In the world about us we actually perceive that the variety of the physical forms and the manifestations of energy due to the combinations of these elements is beyond comprehension. For everything on the earth, in the earth, in the sky above, and through all the starry heavens, *everything* is made of these simple elements. Therefore: *Every manifestation of energy found anywhere in existence is very directly connected with and cannot be disassociated from the so-called primary elements and their combinations. All things arise from the energy of the atoms.*

Heretofore we have been concerned particularly with what goes on within the atoms, the particles of which the atoms are composed, but especially with the manifestations of energy displayed within the units of the elements. Under the head of chemistry we are still interested in the internal construction and the energies of the atoms; for as Millikan says: "The chemical character of a substance depends upon the number of free positive charges in its nucleus." But in chemistry we are particularly interested in the manifestations of energy *where whole atoms of different elements unite as units.*

It is true that in chemical combinations the structure of the atom concerned is a matter of vital importance, and the energies peculiar to the atoms of the primary elements play their essential parts in the chemical combinations. But in chemical combinations, wherein the entire atoms unite, we are in the habit of paying little attention to what goes on within the atoms, and thinking only of the fact of the union of elements and the new energy and material thus produced. From now on, therefore, I shall have less to say about what goes on within the atomic structure. But we must not lose sight of the fact that what has been set forth in the preceding chapter applies with full force wherever atoms are found; no matter whether we are considering it from the standpoint of chemistry, biology, geology, anthropology, or any other department of knowledge.

As we leave the subject of the internal structure of the atom, let us keep in mind that the important fact pertaining to the atom is *the energy therein displayed,* rather than in its physical properties. The *energy in the atom* is a great fundamental fact of nature. "In the beginning, Energy."

We have seen how differences in the structure of the atom, the number and configuration of its parts, produce different elements—hydrogen, calcium, iron, copper, gold, radium, etc.—and how this difference of structure and energy content confers the different physical properties and characteristics displayed by the various elements. *The same principle of com-*

plexity of structure and energy carries on up through the larger structures of chemistry.

Just as the physicist, in studying the building up of the elements, looks upon the electron as a unit, so the chemist in dealing with the various possible chemical combinations looks upon the entire atom as a unit; and just so, later on in our consideration, when we get to discussing biology, we shall see how the biologist looks upon the still more complex structure, the cell of protoplasm, as the unit from which biological structures are built up.

Chemical Affinity

But before proceeding with details I wish to speak of a fundamental fact of chemistry known as Chemical Affinity. Affinity is the chemical attraction that exists between different elements or substances which impels them to unite in the forming of new combinations.

Chemical affinity is therefore an *energy characteristic* of atoms and of molecules of matter. Two elements having their own distinct energy and physical characters approach each other, due to the attraction, the chemical affinity, that exists between them. They rush into each other's arms and instantly a transformation takes place. The electrons assume new orbits in conformity with the stresses introduced by the union. A new product is born. A new physical form is created, new energy characters are displayed. We have created something new, if we may use the word "create" to indicate the accomplishing of a new

result by the combination of two former familiar elements.

This chemical affinity exists not only between atoms of the same element, but between atoms of different elements. It also exists with a very great difference of *intensity*. Between some elements there is so little affinity that it is difficult or impossible to make them combine; others rush together impetuously, accompanied by explosive release of energy.

The chemical affinity which exists between the atoms of like and unlike elements is always present, but it is not always equally operative under all conditions and circumstances. Combinations due to chemical affinity are greatly influenced by light, electricity and other forms of energy present.

But the tendency to combine is always there, and under favorable conditions *the combinations absolutely must take place* in accordance with laws that exist in the very nature of the elements. Brought together under the conditions that favor combination, this chemical union always will take place; in the chemical laboratory, in the depths of the earth, in the roots or blossoms of a plant, or in the stomach or brain of man, in exact compliance with those laws; and the energy manifestations that are displayed as a result of these combinations are just as certain to result in one of these places as in another.

Valency

Another quality of the primary elements that it becomes pertinent to discuss here is that known as

Valency. A brief discussion will be given the subject in order to refresh your memory on this part of your chemistry.

The chemical elements do not all have the same power of combining with other elements. For instance, two atoms of hydrogen combine with one atom of oxygen to form water (H_2O). In other words, it takes two of the hydrogen atoms to *satisfy* one atom of oxygen; for oxygen has twice the valency of hydrogen, and a single atom of oxygen is sufficient to satisfy two atoms of hydrogen.

To picture this to our minds we might represent the atoms of the various elements as little spheres. The atom of hydrogen might be represented by a sphere with a hand on one side only. That is, hydrogen has only one hand by which it can take hold of another atom. But the atom of oxygen should be represented by a sphere with two hands, since it can take hold of two atoms of hydrogen at once.

The atoms of the different elements which are in the hydrogen class, having only one hand, or one point of valency, are known as *monads;* those having twice this valency, like oxygen, are known as *dyads;* those having three times the valency of hydrogen are called *triads.* One triad atom would therefore have ability to take hold of three atoms of hydrogen at once, and should be represented by a sphere with three hands, as it would satisfy three atoms of the monad class. The carbon atom would be represented by a sphere with four hands, as it has four times the valency of hydrogen, and twice the valency of oxy-

gen. One atom of carbon will therefore satisfy and attach to four atoms of the monad class, or two atoms of the dyad class.

Not only is there a difference in valency, the ability to satisfy the chemical affinity of other atoms, but if the figure of the sphere be carried out it is necessary to consider that these hands on the surface of the spheres in the more complex atoms must be arranged in different order for different combinations of the other elements, because the combinations are produced in different ways. Nothing more than mere mention of this fact is necessary here, but the fact does suggest the complexities that exist.

Whereas, *chemical affinity* is the quality that exists in the nature of the elements themselves which impels them to seek each other and to *combine* with each other, *valency* is that quality which determines the *method* of the combination and the quantities that can unite.

Before leaving the subject of valency, it is important to notice here that the very common element carbon, atomic No. 6 and atomic weight 12, is a tetrad, having four points of valency. It therefore finds it very easy to combine with a great many of the elements; and considering the vast quantity in which carbon exists upon the earth, the perfectly natural and inevitable result is an innumerable variety of combinations of carbon with other elements. In fact, it is this quality of carbon, its valency or ability to unite with other elements, and the *ways* in which it unites with them, that make pos-

sible the building up of practically all vegetable and animal forms; for carbon forms the skeleton around which all biological structures are built.

It is well to notice briefly how these natural laws, chemical affinity, and valency, operate in developing or evolving from the original "primary elements" other and very different material manifestations and their correspondingly different energy forms:

Consider the element hydrogen (H) which we found was the simplest known element produced in the hottest stars; very simple in its atomic structure, a central nucleus and one electron; a gas which unites with oxygen at high temperatures accompanied by an explosive release of energy. And consider oxygen (O) an exceedingly lively gas that is always seeking to combine with something else. Combine two atoms of this hydrogen and one atom of oxygen (H_2O) and we have water, a product with entirely new energy and physical properties; very different from either hydrogen or oxygen; a solid below 32° F., liquid between 32° F. and 212° F. at sea level, a vapor above 212° F.

Consider the quiet, almost inert gas, nitrogen (N) which makes up about four-fifths of the volume of our atmosphere. Combine one atom of nitrogen with three of hydrogen (NH_3) and we have a result very different from either, the familiar product ammonia. And while we are mentioning nitrogen I ask you to recall that nitrogen is of particular interest in connection with growing plants, as it proves a valuable aid and stimulant to the plant

and enables it to gather more elements out of the soil *and organize them into itself*. In other words, nitrogen is a great aid to plant growth.

Take chlorine (Cl) a greenish yellow gas, very corrosive and poisonous; and take sodium (Na) an alkali metal with a silvery lustre resembling mercury or quicksilver; combine an atom of sodium and one atom of chlorine (NaCl) and you have ordinary table salt—again a result that could not have been suspected in advance from the nature of either of the elements of which it is composed.

Take the familiar hard element carbon (C) along with hydrogen we have been discussing and the same chlorine that combines with sodium to make salt; combine one atom each of carbon and hydrogen and three of chlorine ($CHCl_3$) and we have the stupefying gas, chloroform.

Starting with carbon again, combine it with life-giving oxygen atom for atom (CO) and you have the very deadly monoxide gas; combine these elements by a slightly different formula (CO_2) and you get carbon dioxide, the gas which is put into your soda fountain drinks presumably for beneficial purposes!

Take again the familiar carbon, hydrogen and oxygen, all elements we take into our bodies freely as breath and food and drink; but combined by the simple formula CH_4O they produce the deadly product, wood alcohol. Vary the formula slightly to C_2H_6O and you have the alcohol produced from grain. Vary the formula again and make it

$C_{12}H_{22}O_{11}$. What is the result now? It may sound still more deadly, but you need not hesitate to give it to the baby this time, for it is nothing but simple, everyday sugar. There are many sugars but this is the ordinary table sugar as produced from the sugar cane.

Take the carbon we eat with our food, the oxygen we breathe, and the chlorine we swallow in our salt. Combine them by the comparatively simple formula $COCl_2$, which means one atom of carbon, one atom of oxygen and two atoms of chlorine, and you have the very deadly phosgene gas that was used by the Germans in the war.

And in connection with this last formula a very interesting and pertinent fact is illustrated. In the dark or in a dim light these simple elements do not want to combine under this formula; but let sunlight fall upon them and they combine quite freely. What is the explanation? There is energy in the sunlight, vibration, radiant energy that excites the electronic structures of the atoms of these elements. The electronic structures are such that under ordinary conditions they do not want to change and blend, but under the excitement and increased activity of the electrons produced by the sun's rays they are "loosened up" so that they unite freely.

Nor is there anything peculiar in this. The same principle is illustrated in every leaf and every blade of grass growing under the sunlight the world over. The sun's rays falling upon the leaves play upon the elements and molecules in their cells and

stimulate them into forming new and more complex combinations. It is a chemical process, but it is also a life process which we call growth.

Just as the elements that make the phosgene gas, and which find it difficult to combine in the dark, are aided by sunlight, so the plants find the sun's rays a great aid and in most cases a necessary factor in the process of cell growth and organization.

Take the same familiar elements we have been discussing, carbon, hydrogen and oxygen, and combine them under the formula $C_6H_{10}O_5$. This time the product is starch, the same starch that is produced in the grain of corn, wheat, the potato and plants in general.

But this is not to run on into a treatise on chemistry. I only wish to illustrate certain basic principles involved, and these few simple examples will serve the immediate purpose. I ask you to note how the combination of simple elements produces *brand new products,* having not only different *appearances,* different physical characteristics, but displaying entirely *new manifestations of energy.*

The combinations that have been mentioned above are exceedingly simple ones. Remembering that there are various *methods* by which the elements unite, that the elements unite in varying *quantities,* and that very frequently *many elements* unite together by more than one formula to produce entirely new products, and that the sum total of these primary elements now known is nearly one hundred —it will be perfectly clear that *the number of ulti-*

mate products that are possible from these unions is practically unlimited.

Not only must innumerable physical products be produced, but, since energy is the really important thing within the atom, innumerable corresponding *energy forms* must be produced by these chemical conditions. We must expect to see energy displayed in a great many new and very different forms. And that is exactly what does happen; and as the complexity of structure rises to new heights in plant and animal forms we discover still other and different forms of *biotic energy,* life energy.

In the former chapters, from what is taking place in the hottest of the stars and then those that are cooler and cooler down to worlds of the character of our own sun and earth, we have the process of *the evolution of the elements.* In the chemical combinations of the elements the process continues, and we see the *evolution of the substances* of which all the more complex inorganic and organic bodies are made.

Thus we see not only the operating *cause* and reason why inorganic evolution has taken place and is now continuing, but the *course* of that evolution is actually plain. The operating cause of this evolution, or development if you prefer that word, is the energy inherently existent within the atoms and the molecules; the course follows the paths laid out by the laws of atomic structure, atomic weight, of chemical affinity, and valency. The changes that occur are controlled absolutely and entirely by the

energies present, and by the contacts of earlier material forms incident upon the motions produced by the inherent energies. Not by fiat, but by a sublimely beautiful, lawful process of evolution were all things made. Time, long, long time, was a material factor, and evolution due to electronic energy, atomic energy, chemical energy, was the process.

Colloids

What we have been dealing with in this chapter up to this point has been principally the energies that exist in and between atoms. By virtue of atomic affinity atoms are brought together and molecules of matter are thus produced, through the satisfaction of *atomic affinity.*

But now it is important to realize that when these molecules are themselves brought together under satisfactory conditions another affinity is discovered, the affinity of *molecules* for each other. This we may term *molecular affinity.*

From now on we are no longer dealing with the primary elements as such. We are dealing with molecules, built up by the union of atoms of perhaps several of the different primary elements through chemical or atomic affinity. The molecule is therefore a still more complex structure. Molecules of matter do themselves, by virtue of their molecular affinity, organize themselves into still larger structures, after much the same principle as that by which atoms combine to form molecules.

But in the molecular structures here referred to,

the binding together of the molecules is not nearly so close, the tie is not so absolutely tight as in the case of atomic union. Various numbers of molecules may unite together, 10, 20, 30, up to as many as 60 molecules, all organized into one large unit. But this unit is a loosely bound structure, with a quality which, in order that all may visualize it better, we may call flexibility. It has the capacity to reach out into the surrounding media, and if that media be of a satisfactory quality it can lay hold of and organize into itself other molecules which are found therein.

Such a molecular organization is known as a colloid structure. Such structures are still strictly inorganic and may be produced in the laboratory in great variety with comparative ease. They are also found in nature in great variety and volume. While inorganic, at the same time it must be recognized that the colloid structure has associated with it numerous qualities which are closely akin to those of living matter. The colloids are the connecting link between strictly chemical structures and biological structures. And just as there is no abrupt dividing line between chemical unions and those other unions which produce colloids, so it is difficult to define the dividing line between colloid structures and living organisms. In fact, bio-chemists have to deal with both the known laws of chemistry and established laws of biology.

In the laws that govern molecular union in colloid structures, we find a very close analogy to those

laws which govern atomic union in chemistry; in fact they seem to be but a different application of the same laws. For instance, just as in inorganic chemistry we find the law of atomic affinity, so in colloids we find the law of molecular affinity; and just as we find the fact of a differing valency in the atoms of different elements, so we find a true valency of molecules; and just as some of the atoms have little affinity for some and powerful affinity for others, so it is among the molecules; some molecules do not care to unite, while others unite violently accompanied by the release of much energy in the form of heat.

A very important thing to note here is the delicate, loosely bound structures of the colloids, because the structures of all plants and all animals are essentially colloidal in nature. Because new parts can be added and old parts subtracted easily, *it is exactly suited to the life process,* where we see such addition and subtraction continually taking place.

In fact, it is obvious that only a colloidal structure is adaptable to living organisms, where the processes of upbuilding and tearing down and eliminating go on with more or less regularity so long as life continues. When death comes to the plant or animal, then the entire colloidal structure begins to break down rapidly, there is no more rebuilding, and the complex molecular structures soon return to simpler forms.

It was previously stated that the colloid structure forms and grows in satisfactory media. It reaches

out into the surrounding media and by the energy of affinity lays hold of molecules which it craves, and builds them into itself. This is the process of growth in colloids and in vegetable and animal forms. In the animal it is the function of the digestive juices to take the foods that are offered, treat them chemically, and provide the satisfactory nourishment for the colloidal structures of the body. The digestive juices tear down the complicated vegetable or animal organisms that are put into the digestive tract, and through chemical action produce the substances required to renew the body cells. These substances or cell foods are carried by the blood through the entire body, brought in contact with the cells, molecular affinity asserts itself, and the molecular structure, the cell, takes up the desired molecules of cell food and builds them into itself. Thus the latent chemical energy of the food is transformed into the energy of the animal. The process of digestion is a process of tearing down colloidal structures; the process of assimilation is the reverse process of building up new colloidal structures.

The same principle applies in the case of the growing plant. The details of its application are somewhat different, due to the different nourishment available and the needs peculiar to a quite different organism. The digestive processes of plants differ also one from another according to the differing needs of the plants, just as the digestive processes of animals differ according to the varying

needs of the various animals; but the same general bio-chemical laws apply.

The colloidal structure of matter is, therefore, a peculiarly dynamic state of matter. It possesses energy, *the power to do work;* and by reason of the fact that its parts are not tightly wrapped up in each other it obeys its tendency to reach out in its surroundings and employ its energy to do work. In other words, it is not static and in equilibrium, but unstable, and so it exhibits a tendency to do something, to grow, and to move. The fact is that the active parts of the cells of all plants and animals are colloids.

Take the organizations next higher, the lower biological forms. We can now see these same colloidal structures actually undergoing the changes incident to real life. The colloid structures which may be produced from chemicals in test tubes in the laboratory may be seen under careful observation to take nourishment, and grow. Macfarlane[1] says: "To speak of the nutrition and growth of some inorganic colloid mixtures or unions is as appropriate as if we spoke of those in a yeast cell or amoeba.

"Living bodies have arisen in a continuous and graded fashion from an inorganic stage, while the same laws that govern inorganic bodies are directly applicable to organic, except that the latter show more perfect exhibitions of some kinds of energy, and probably in connection therewith exhibit condi-

1 John Muirhead Macfarlane, *The Causes and Course of Organic Evolution.*

tions of environal interchange or respirations that have not yet or only imperfectly been demonstrated for the inorganic."

In the colloids, then, we have discovered a new physical form of matter, the jelly-like structures of molecules found in all plants and animals. Here also, are new manifestations of energy, the phenomena of *assimilation, nutrition, growth, and movement,* with changes of level in energy *from lower to* higher and higher to lower actually taking place.

Once more, therefore, in the realm of chemistry, we see perfect law, order; cosmos, not chaos; and at the bottom of it the always-present Energy.

CHAPTER V

THE BIOLOGIST SPEAKS

Law, Order, Cosmos, God

In the beginning, God.

In the modern language, the language of the biologist, the scientist and the philosopher, in the beginning, Energy.

The physicist has shown that the unit of matter is the *atom,* composed of the outer electrons and a central nucleus. In the atom we find electronic energy, and from it emigrate the alpha, the beta, the gamma rays. Here we find electricity and motion. We find various manifestations of energy, with matter at the very minimum of manifestation. In this department of physics, the study of the atom, the outstanding and fundamental thing is the energy of the atom. "In the beginning, energy."

The chemist has shown that the unit produced by chemical action, the *molecule,* is composed of atoms. The chemist reveals how the various atoms, different in structure, material and characteristics, and the amount of energy impounded by them, combine together and produce a new unit. In this act of combination new energy forms are born. Here is atomic as well as electronic motion, *i. e.,* electric-

ity in a new form. At the same time new materials are produced, the products of chemical combinations being entirely different from the ingredients combined.

The scientist who specializes in colloid chemistry can prove the *colloid* to be a new and still more complex organization, a concentration of molecules. In these combinations matter again assumes new forms accompanied also by new forms of energy known as the energy of the colloid. Here in the colloid is movement, and a capacity for the organization of molecules together in a manner that we understand by the word growth—which is new again. This growth is a slower union than is the union that arises out of chemical affinity, and the union of colloid parts is not so close-knit. It is less binding, less stable.

Now in the realm of biology we find that the *cell* is the unit of combination and, true to the principle operative in physics, chemistry and the colloids, that each unit is composed of a number of units of the next lower order, we find that the cell is composed of colloid structures. The cell of which all living things are made is a colloid combination. It is the logical next step after the building of atoms from electrons, the building of molecules from atoms, and the building of colloid structures from molecules.

Obviously, the cell structure is a very much larger one than that of molecules or atoms and is exceedingly complex in comparison with atomic,

molecular or simple colloid structures. Furthermore, true to the principle that has been heretofore revealed, along with the increased complexity of structure of the protoplasmic cell new energy forms come into existence. Here is the capacity and power of growth on a higher scale than is found in the simple colloid. Likewise the attribute of motion functions on a higher scale than is found in the atoms, in the molecule or the simpler colloid groups.

In other words here is *biotic energy.* We have already discovered energy as *electric, thermic, chemic;* now after the transformation undergone by the old forms in the cell we call the new energy forms thus obtained or created, *biotic.*

We have followed the various steps. In the beginning electronic energy, then atomic energy, then molecular energy, then colloid energy, now biotic energy—the energy present in the simplest things we call living. All is demonstrably shown to proceed and rise in logical, natural order. And *there is no energy of the protoplasmic cell which does not arise out of the units of which it is composed. It is the original energy of the atom transformed successively into other and higher forms.*

Just here we come upon the stumbling-block for a great multitude of minds in their effort to comprehend the mystery of life. How explain this mystery of life, of growth, of selectivity, of movement that characterize the living cell? Begin at the living cell and it will remain a dark secret. Go behind the biotic form of energy through the chemic, thermic

to the simple beginnings of energy in the hydrogen atom, and the mystery gives up its secret. Then it becomes plain that the living cell is just one more combination of the organizing principle of growth, of selectivity and of movement that are found in the chemical combinations of the simplest atoms. It is the same principle carried a few steps higher. It is the same original energy working out logically to a more distant conclusion. And while many minds halt at this obstacle, it is fundamentally no harder an obstacle to surmount than the obstacle involved in the mystery of chemical affinity, and the new energy forms that arise out of new combinations of different atoms. Once we understand more fully what goes on within the atom and what takes place in the chemical retort the key is put in our hands by which we can more clearly understand the so-called *biologic energy* which we call life. For biology arises directly out of chemistry. It is the next step in complexity of molecular construction, and the biotic energy forms that are found in living things arise directly out of the chemical energy and the atomic energy found in simpler forms of matter.

Here then we are brought face to face with the origin of life. The point cannot lightly be passed over. It is obligatory upon us to improve our opportunity here to grasp nature's greatest truth and state it in simple language. And that fundamental truth seems to be this: Inherent in the very nature of energy and matter we have discovered through the electron, the atom, the molecule, the colloid and

the protoplasmic cell a natural law of progress, a law of growth. We have discovered that when two atoms are brought together under proper conditions of non-interference they *must* combine. There is something inherent in their nature that compels it. Chemical affinity exists in the very nature of things.

We have also discovered conditions under which molecules of matter brought together *must* combine. They cannot then keep apart any more than oxygen and carbon can keep apart in high temperatures. The very nature of the elements makes them leap into each other's arms, form chemical combinations, release energy and give rise to new material forms.

Just so the protoplasmic cells carry on, on the same principle. They associate themselves together in exceedingly complex and varied ways, as can be inferred from the exceeding variety in form and character of living things, vegetable and animal. At the same time, and exactly parallel, the increasing variety of material forms are accompanied by an increasing variety of energy forms. The multitude of vegetable growths are characterized by the use of a multitude of these new energy forms.

Still higher, in the realm of animal life, (and there is no definite dividing line between the vegetable and the animal) there is a wondrous variety of living forms paralleled by an equal variety of new energy manifestations. This is but the working out of the law of energy and matter to its higher and logical conclusion.

Here then, we are now ready to state the fundamental law with which we are to be particularly interested throughout this entire book. *In the very nature of energy and matter is a law which makes for progress; units of matter of various sizes and characteristics tend to combine, and in combining they produce entirely new material and energy forms; and when the conditions are satisfactory for such combinations the law absolutely MUST operate and growth MUST take place.*

This is the law in operation throughout all nature. It is absolutely fundamental. The proof of its existence and operation is found everywhere and always. It is universal and imperative.

The union of the simplest atoms, hydrogen and oxygen for instance, is very quick and violent, explosive in its suddenness and in the sudden release of energy. The union of more complex atoms is much slower, and the union of the molecules slower still. Colloid unions require still more time for their completion, while the organization of biologic cells and organs is slowest of all and they release their energy much more slowly than any of the simpler structures.

And here is another fundamental principle. The farther back we go toward the simpler material and energy forms, the closer approach we make to the original energy from which atoms are built, the more tightly we find the units of material structure locked together. For instance, the parts of the atoms are locked together in such an intense grip

that it is only very recently that scientists have learned how to disrupt an atom. Its parts are held together by an almost irresistible force, and tremendous power has to be applied to separate an electron from its atom.

But with rising complexity of structure in chemical unions, colloid structures and cell growths, there appears an increasing looseness and instability to these combinations. Chemical affinity locks different kinds of atoms rather tightly together; not so tightly, however, but that they can be separated again easily as compared with the difficulty encountered in separating the parts of an atom.

Just so, colloid structures are still more loosely bound together than are the simple chemical combinations, and so colloid structures may be torn apart with much greater ease; and the protoplasmic cell, which is a colloid structure of much greater complexity, is still more easily broken down. In other words, with increasing complexity of structure there goes a lessening stability of equilibrium.

The physicist has shown that with increasing complexity of structure of the atom, the point is reached where the atom becomes unstable and begins to disrupt itself, becomes radioactive. So with increasing complexity of structure of colloid combinations a point is reached where the cell becomes unstable and throws off parts of itself. In order thus to continue giving off energy and survive, the cell must acquire new energy. The cell gets this new energy through its power of appropriation. By a higher

application of the principle employed by a chemical element in laying hold of and combining with itself other elements, the protoplasmic cell is endowed with a capacity to lay hold of other matter with which it comes in contact and take it up into itself. Here in the cell there is carried out to a higher success the same principle of loss and gain operating in the simple colloids—both elimination and assimilation. In other words, here is growth and what we call life.

For growth is but a process of appropriation and a capacity for organization of the simpler into the complex. This principle of growth, which characterizes all living things, is hinted at back in the colloid, which is a sort of borderland between chemical affinity and biologic activity, for there we first find this power of appropriation and capacity for organization of the simpler into the complex, with its accompaniments, elimination and assimilation. In the cells of which all plants and animals are composed this same principle is carried on to higher degrees.

True to the same principle, the biologic cell manifests in more wonderful fashion than any simpler structure both the power of growth and the display of new manifestations of energy. With increased assimilation there is accumulated within the cell a surplus of energy, just as a surplus of electric energy may accumulate in a storage battery. This results in division of the cell into two parts. It becomes two new cells, and these cells in turn repeat the proc-

ess. Here we have energy displayed in a new way and growth taking place after a new fashion, but all in absolute harmony with the principles heretofore pointed out.

In the chemical union we found a peculiar type of energy transformer. The energy of the atoms that are combining manifests itself in new forms. The energy charge of the atoms may be transformed into heat, and in some instances a flow of energy currents be set up, as in the galvanic battery which operates through chemical action. The protoplasmic cell is true to the same principle, but acts as a more complex energy transformer. In doing so, it merely carries out the same law of transformation of energy in a new realm, the biological realm. The cell lays hold of molecules with which it comes in contact, absorbs them, works what it can use up into its own structure by means of chemical action much as a stomach digests food by chemical action. The cell retains what its chemistry craves and rejects the rest as of no worth to it. It is strengthened by the energy thus absorbed, and when it gives out that energy it gives it out in new forms peculiar to itself.

The fundamental characteristic of the protoplasmic cell is therefore its action as a transformer of energy. It takes energy in certain forms and manufactures from them new forms of energy. It takes matter of certain forms and qualities and after that matter has passed through the chemical laboratory which it operates, it assumes new forms and new

characteristics. To put it all briefly, the protoplasmic cell takes in energy on the inorganic level and gives out energy on the organic level; the energy that it takes is non-living energy but the energy it gives out is in the forms which characterize what we call *life*.

Put into a glass jar some water, a little sulphuric acid and a piece of zinc. In other words put in energy, the energy of the atoms that form of these materials. Now conditions have been supplied whereby chemical action can take place. Therefore, true to the Fundamental Law, action *must* take place. It does. It cannot be avoided. What is the result? Atoms of the oxygen combine with the atoms of zinc, and in the process energy of a new form is produced, an *electric current* which will flow through a wire and do work. At the same time we have produced another form of matter, zinc oxide and the corresponding atoms of hydrogen which have been released will escape into the air.

Just so, consider coal, the energy which it now contains within itself has been stored there by the very action, such as we have been discussing, of living cells. We may burn that coal and through the combination of oxygen and carbon in the burning release that stored energy in a new form, heat. Put the heat under a boiler containing water and we change the form of water into invisible steam. And at the same time we transform energy from heat into pressure. An engine will transform that energy of pressure into the energy of motion on a

belt; we can run the belt over the pulley of a dynamo, transfer the motion to the armature of the generator and out comes the same energy in still another form again, electricity. We may run the electricity through a resistance coil and produce heat again for the toaster on our table; we may run the energy through a filament in a vacuum bulb and transfer some of that energy into light when a considerable portion of the energy will be again transformed back into heat. We can transform the nature of the current at will from low voltage and high amperage to low amperage and voltage so high that the energy leaps from the wires and travels through space as what we call wireless waves.

Just so the energy stored in any of the atoms may be transformed by suitable processes and through suitable equipment into an endless variety of forms. The biologic cell is but another one of these transformers of energy. It takes in the energy of the atom, transforms it in the process of working it up into its own structure, and gives it out again in the myriad forms that characterize all living things, both vegetable and animal.

And this principle and process holds good for the very highest manifestations of living things. But before taking these up specifically it may be well to consider some other particulars in relation to the development of protoplasmic cells.

Now the field of biology extends from the simplest living cell through all the entire realm of vegetable life as well as through the entire animal world

up to and including the most cultured and educated human being. Obviously, its scope is so exceedingly broad that nothing but the merest outline can be given here. However, this book is a discussion of fundamental things and the fundamentals of biology are all that we need point out at this time.

We have seen how the cell has a capacity for organization. We have also seen that the cell multiplies by division.

Some cells when they divide separate and live apart. This is true of many of the bacteriological cells. They remain one-celled organisms, unicellular.

But other cells do not separate when they multiply by division. They yet remain bound together. Tied together by tissue, they neither clash nor ignore one another's presence but work harmoniously along the same line in the taking in and giving out of energy. They continue to feed upon the same kinds of molecules, carry on the same internal chemical operations, and give out not only the same forms of energy manifestations but their residue of elimination coincides in chemical analysis. Such an aggregation of cells becomes an *organ.*

An interesting variety of *organs* whose chemical compositions are different, whose functions and purposes are different, is possessed by most plants. The rootlets become adapted to one purpose, the stems to another, the leaves to a third, the sexual or reproductive organs to a fourth, and finally the seeds to still another office. Here is division of

labor, specialization of function, yet harmonious co-operation for the good of the entire plant. In the earliest plant forms there is little of this specialization, little development of special organs. But as we ascend the ladder of vegetable and animal development the number of organs increases and their functions become more highly specialized.

The organs become most highly developed among the higher animals, and especially in man. The brain of man is probably the most marvelous organ in existence. Like the stomach, the spleen, the thyroid gland, the pituitary body, or the simple protoplasmic cell, the brain is an energy transformer. It takes in energy, supplied by the food we eat, from the blood, and transforms it; and true to the principle that holds good all the way back down the line to the original atoms, the output of the brain is energy in a new form—*psychic* energy.

Who is so careless an observer that he does not know that good quality mental action depends upon proper food and a well nourished body? Who has not observed that the ability to think soundly is dependent upon normal chemical conditions in the body? Put alcohol into the stomach of a man and it will disturb his chemical normalcy to an extent that may be quickly observed in his mental reactions. First his moral ideals or standards of conduct are affected and the man is willing to do things he would not do when strictly sober. As more of the alcohol gets into the blood and is carried to the brain, other of the higher phases of mental activity

are affected; he cannot think rationally, and he talks foolishly. Later if the dose be heavy enough, even the lower life processes are injuriously affected; the man loses his ability to use his legs properly. In the end all the higher energy manifestations that characterize animal life suffer a temporary paralysis; only the heart action and respiration continue, and this noble animal, the highest product of the entire work of Creation, is reduced almost to a state of suspended animation. If the disturbance has been violent enough death may ensue.

Now among the many organs of the human body are several it is desirable to mention here. For instance, there is a mass of cells located in the front of the throat which constitute a certain organ, named the thyroid gland. This gland takes up out of the blood certain elements, works them over through a chemical process within its own cells and sends back a new substance into the blood which is known as thyroxin. This new product, true to the principles of chemistry, as well as of biology, exercises an influence all its own upon the other parts of the great aggregation of organs, the human body. Of this more later.

Other cells develop in combination along other lines. Some become muscular tissue, the seat of energy manifestations of a peculiar character. They have the power of tightening up, accomplished by a great multitude of them operating in unison. This we call muscular contraction. Other sets of cells become nerve tissue, or brain structures, dif-

ferent in appearance and producing entirely different energies. Other cells combine to make bone, the character of their formation being such as to provide the necessary rigidity required of them.

As stated in the early paragraphs of this chapter, the protoplasmic cell is the unit of what we call life energy. That this life energy is essentially the same in all forms of living things, from the lowest vegetable organism to the most complex cell structures in the body of man, is supported by a vast amount of evidence, only a little of which can be presented here.

Cell life everywhere throughout the vegetable and animal world responds in uniform fashion to chemical reaction. If an injection is squirted into a plant which disturbs the normal chemistry of the organism, it injures or destroys the life energy. The plant sickens or is killed, depending upon the violence of the chemical disturbance. For instance, consider the following simple experiment:

My pupils had brought a bouquet of flowers for my desk, among them a large white iris. We put this by itself in a vase filled with fresh water. Left under these conditions the flower would remain fresh for at least a day or two.

But we then put into the water some ordinary red ink made from coal tar dye. In a few minutes the red color made its appearance in the veins and the class watched the process of the flow of the sap until the entire circulatory system of the blossom was well outlined in red. About this time other things

occurred. The petals became limp, and soon had thoroughly withered. Within thirty minutes from the time the color was put into the water the beautiful white blossom had been poisoned to death.

The same general experiment may be repeated with endless variations. Plants may be put to sleep with ether or chloroform and the life processes are retarded in exact proportion to the degree of anaesthetization. Under sufficient exposure to the ether or chloroform, a plant will be killed exactly as an animal would be killed.

If a plant that has been put partly under the influence of the gas be again exposed to fresh air it soon awakens into life again, slowly recovers its normal plant tone and in due time resumes all its former life processes. Where the exposure to the ether or chloroform is too heavy and prolonged it is impossible to revive the plant, and the processes of destruction that follow death begin.

Again plants, like animals, are subject to bacterial infection and disease and the history of plant pathology is in harmony with animal and human pathology. The symptoms are harmonious, considering the difference in complexity of organism and the difference of planes upon which the life energy is manifested.

Again, as is well known, heat accelerates the action of the cell in plants and cold retards that action. The same principle applies in animal life. It has been shown that the duration of the life process in plant or animal may be stated almost in mathe-

matical terms based upon the duration of exposure to different temperatures at different times.

To clarify this point, consider the life history of the honey bee. The bee that first takes wing in the month of June has finished its normal life cycle and is dead within six weeks. It has lived through the warm summer months. Life has proceeded fast and is soon finished. But the bee that first emerges in October or November lives over until the following May. It is alive, but its life is at a very low ebb of animation through the cool months. Through January and February except in the tropics it lies dormant and almost dead. By the law of average it is entitled to a longer period of life than the bee that lives the fast and furious life in the warm summer months, and it gets it.

Furthermore, it has been recently discovered that the individual cells of which all plants, including the giant trees, are composed expand and contract somewhat after the fashion of the human heart. This expansion and contraction causes the flow of sap through the plant and under favorable conditions produces a sap flow of as much as one hundred feet in one hour. This pulsation has an average time cycle of about fourteen seconds, sometimes faster, sometimes slower. During the cold months when the plant is dormant the cell pulsation is at its lowest beat and the sap practically ceases to flow. Thus all the cells of the plant co-operating together produce the sap circulation just as the human heart produces the circulation of the blood.

In the chapter on chemistry we saw something of the complexity of chemical combination; how various numbers of atoms of different elements combine in different ways and produce new substances, whose chemical formulae appear to the layman as very complex. But the complexity of the chemical combinations there referred to are simple as compared with the much greater complexity of the biological structure.

For the purpose of comparing the complexity of chemic and biologic combinations a few of the latter will be given here.

Perhaps a sufficiently well-known product of biologic chemistry to select will be the common wheat of which our daily bread is made. Its principal part is starch. In the chapter on chemistry it was shown that starch is a combination of six parts of carbon, ten of hydrogen, and five of oxygen, giving a chemical formula of $C_6H_{10}O_5$. In addition to the starch wheat contains gluten, a much more complex structure, the formula being $C_{185}H_{288}N_{50}SO_{58}$. The caffein in your coffee is merely $C_8H_{10}N_4O_2$.

Turning now to the higher forms of animal life, the composition of the albumen in the blood of vertebrate animals is found to be approximately $C_{450}H_{720}N_{116}S_6O_{140}$. Note the greatly increased complexity. The haemoglobin of the blood of man has the formula $C_{600}H_{960}N_{154}Fe_1S_3O_{179}$; while the haemoglobin of the horse is built up after the formula $C_{712}H_{1130}N_{214}Fe_1S_2O_{245}$, according to Verworm. Zinoffsky also gives the latter formula. I

believe no great accuracy is claimed for these formulae, but the important thing I call attention to is the exceedingly great chemical complexity of structure in these important parts of the blood.

The central point of it all is this: through that law of growth which is basic, operating through vast eons of time, energy and material forms have now developed to an exceedingly high state of complexity, the highest form of which is found in the gray matter in the brain of man. For the brain cell is but a logical consummation of these same inherent laws of energy and matter, operating through the long periods of time that the earth and its atomic, molecular, colloid and protoplasmic cell forms have been developing; and true to the universal principle, we would expect to find such a wonderful and complex structure as the human brain cell to show very remarkable energy manifestations. It does; for out of that exceedingly complex organ, the cortex of the brain, arise the energy phenomena of the emotions, of love, of hate, of thought, of memory, of our conceptions of morals, the faculty of reason, and all the higher reaches that characterize the mind and the spirit of man.

Even in the realm of botany as we ascend the biologic scale, we discover the energy manifestations also advancing to higher and higher planes, until some plants seem to have a species of knowledge, though it is not knowledge, nor does it possess anything like the thought quality of the human brain. But many creeping plants do have the tactile sense.

The tendrils of climbing vines bend around, grasp, and hold on like hands to supports that keep them up in the sun. Other plants have the phototactic sense and know which way to bend or travel in order to reach the light. These simple things are familiar to all of us. Of course, as we ascend higher into the animal kingdom we find very greatly increased knowledge and ability of this kind; knowledge of better means by which to obtain the things that are desired for a better animal life, and better ability to seize and make use of those things. In the lower animal forms for instance there is very little power of locomotion, but with the increase of complexity of structure goes an increased power of locomotion required to extend the environment in which it may forage for its sustenance.

These are all working proofs of the fundamental law, that there exists in the very nature of energy and matter a tendency to complication and growth; and that complication and growth may be traced step by step in more intricate material forms and higher energy manifestations successively through the entire vegetable world, through the animal kingdom, through the lowest human savage forms which are little better than wild beasts, through the tribes of higher and higher intelligence and nations of higher and higher culture, until we reach the point of highest development yet produced by the operations of this fundamental law of complication and growth, the most cultured and intelligent human being.

When life first appeared upon the earth it was by reason of the energies and the elements previously in existence taking another step up in the scale of complication and growth through physico-chemical action. It was not something entirely separate and distinct, a thing apart from chemistry, but it was a product of the continuation of the operation of the natural law of development and change that carried the process a step higher than the realm of chemistry. All investigation indicates that the physico-chemical explanation is the correct explanation of life and all biological processes. Life is not an exception to the laws found operative elsewhere throughout the cosmos; life is only one small part of the one great process of development. No form of energy can be found in living organisms that is not also found in or derived from the inorganic.

It appears that life could never have been produced without the union of at least ten different elements, for on the best evidence we have today hydrogen, oxygen, nitrogen, carbon, phosphorus, sulphur, potassium, calcium, magnesium and iron are all essential to life. This at once suggests the complexity of the simplest structure in which the life form of energy can be manifested. It would appear that all these elements in proper proportions and combinations would have to be present in the simplest life organism. As a matter of fact, all these and nineteen more of the so-called primary elements are found in the various forms of living matter. The human body, including the brain, is made up of

various percentages of twenty-nine of the so-called primary elements.

Some of the lower biologic organisms, the prototrophic bacteria, obtain their nourishment entirely from inorganic matter, the so-called original elements, such as sodium, potassium, phosphorus, magnesium, sulphur, carbon, chlorine and nitrogen. They are feeders on the inorganic. Here we have examples of the living obtaining nourishment and multiplying into various new lives directly from the lower forms of the inorganic or non-living. These bacteria are energy transformers, transforming non-living energy into living energy.

Just what the nature of the life energy is it is difficult for us to comprehend, but probably no more difficult than for us to comprehend electrical energy, heat energy or energy in any of its other forms. We know how to handle electricity, but we do not yet comprehend what it is. We know it is the movement of electrons through electrical conductors, but what electrons are or why and how the flow produces its various phenomena is still beyond the grasp of our human intellect. Just as electricity, magnetism, gravitation and chemical affinity are as yet unexplainable, so life is as yet not fully explained. Life is a phenomenon of energy not yet fully understood. But just as we know pretty well the laws for the production and manipulation of electricity, magnetism and of other forms of energy, so we understand in a measure the laws of life. The mystery of life is in a class with the mystery of matter, of energy, of

chemical affinity, and of gravitation; and it is not to be lifted above the mysteries identified with other forms of matter and energy and put in a class by itself except by reason of its higher complexity, and its association with more complex material forms.

Biological energy or the phenomena we call life is of the same order as other energy phenomena and no more supernatural or difficult to understand. It is energy in another form, but one that runs very parallel to electrical energy and chemical energy, and we may yet learn through laboratory research that the life energy of the cell is but a metamorphosis of the electrical energy of its component parts.

Mr. W. J. V. Osterhout, of Harvard University, has made some interesting researches along this line. Experimenting with a sea plant known as laminaria he found that the electrical resistance of the plant was an excellent index to its condition of vitality, its life. When the plants were exposed to elements which are known to be injurious the electrical resistance of the plants changed at once. Mr. Osterhout says:

"If, for example, it is taken from the sea water and placed in a solution of pure sodium chloride (salt water) it is quickly injured, and if the exposure be sufficiently prolonged it is killed. During the whole time of exposure to the solution of sodium chloride *the electrical resistance falls steadily until the death point is reached,* after which there is no further change."

It was found possible to follow the process of

death of organisms in the same manner that the progress of chemical reaction can be followed. The two go parallel. Mr. Osterhout further says:

"Since the electrical resistance of the living tissue is about ten times as great as when it is killed it is evident that the living protoplasm must be responsible for the increased resistance."

Endless examples might be cited to show the family relation that exists between life energy and electric and chemic energy. But we must content ourselves here with stating the principle and illustrating it by these few citations.

Certain chemical combinations cannot be made in the laboratory, or are made with difficulty, except in sunlight. When the sun's rays, however, fall upon the element in question, the combination readily forms. In every blade of grass, in every green leaf, the same principle is on display, for in all green growing things wonderful chemical combinations occur which do not take place except under the influence of energy coming from the sun. The incoming solar electrons of the sun's rays play upon the elements in the leaf and in the sap, and under their stimulus these chemical combinations take place.

A more detailed description of the kind of chemical action which takes place in the cells of the leaf will be of interest and value here. Starch is an important and common plant product. Consider the method of its manufacture in the plant cell. Starch is a relatively simple chemical product, and, like all other things, is built up from the simplest elements.

As was shown, it contains only oxygen (O), hydrogen (H) and carbon (C). Consider the possible process of its manufacture in the plant. Simple water (H_2O) supplies the hydrogen and oxygen, while carbon is obtained from the ground and from the air. Oxygen unites with the carbon as CO_2, producing carbon dioxide. This, added to water $(H_2O+CO_2)=H_2CO_3$. Combine two of these products and we have $2H_2CO_3$. Now, the oxygen atom is exceedingly lively. True to its nature, it escapes, or, as we say, is thrown off, by the green leaf. This leaves $2H_2CO_2$, or $2CH_2O+O_2$, or formic acid. Again, oxygen escapes, leaving $2CH_2O$, or formaldehyde. Three of these groups combining make $6CH_2O$, which is equal to $C_6H_{12}O_6$, or grape sugar. Water also evaporates from the leaf. Take a molecule of water (H_2O) from the grape sugar ($C_6H_{12}O_6$), and there is left $C_6H_{10}O_5$, or common starch, the starch of the potato or of the wheat grain which we make into bread.

This is an inside glimpse of the wonderful chemical processes which, under the stimulation of the sun's rays, build up and produce all sorts of complex structures from the simpler elements. And it is perfectly clear that the variety of new forms and differences in character that are possible is practically infinite. Please note, too, that while the process is truly chemical, *it is the very life process* itself. The whole life process and the death process throughout the entire vegetable and animal worlds

may be expressed in terms of chemical changes and the accompanying and parallel energy changes.

Reproduction

Since colloid structures may be truly said to exhibit functions of growth, assimilation and elimination, reproduction remains a peculiar function of the truly living cell; for reproduction is an energy manifestation that takes place only in structures of the complexity of the protoplasmic cell or higher, never in the colloid forms of lower complexity. And yet the reproductive process is so fundamentally chemical that an unfertilized egg, which is essentially a colloid structure, may be fertilized by chemical means in the laboratory and made to bring forth living creatures. It has been done repeatedly by purely physico-chemical means. Fatherless frogs, star fish and mollusks are no longer a curiosity to the biologist, for he can produce them at will in the laboratory. Thus, here in the wonderful phenomena of reproduction of the species we find that not only biological laws are employed, but that purely chemical and physical laws control; for fundamentally the laws of biology arise out of the laws of physics and chemistry; or, stated still more accurately, biologic laws are but physical and chemical laws operating in those higher planes of their application, the more complex colloid structures.

This, then, is the story of the origin and the nature of life, very briefly told. Only the outline of the process has been given, but I hope that enough

has been presented to make clear the way of the creation of living things. This does not pretend to be a complete and thorough presentation of the pertinent facts that exist bearing upon the question. Many thousands of known facts that are strictly pertinent to the issue and in absolute harmony with what has been presented might be given to fill in and elaborate and complete the story. But it would never be possible to present all the facts; even to attempt it would require a lifetime and the writing of not only a book, but an entire library.

From this brief outline the process of the creation of life can be understood; and even a faint realization of the perfection of this process, its absolute order and system and law, will give the most callous a new admiration for the wonder and beauty of it all.

Life, and the origin of life as it is understood by the biologist today, is truly a thing worthy of our highest respect and admiration. The new vision of life, the vision which is now made possible by scientific research and discovery, enables men today to realize in a more profound way how wonderful and praiseworthy the works of creation really are. For the highest task to which man can set his mind is the attempt to discover and understand the processes of the infinite; and in proportion as man understands more and more of the wonders of nature, in that same accumulating proportion he understands and admires and loves the Supreme Intelligence which he has there seen displayed. The most truly

devout man is the one who knows most of the innermost secrets of matter and energy in their sublimest forms.

The scientific world today fully and frankly recognizes the fact that life energy arises out of lower energy forms, and that the higher living things found on the earth today are the product of age-long development or evolution. Scientists have been much misquoted on this point, and to correct erroneous impressions the Council of the American Association for the Advancement of Science, at its annual meeting in Boston, December 26 to December 30, 1922, adopted the following resolutions:

A STATEMENT OF THE PRESENT SCIENTIFIC STATUS ON THE THEORY OF EVOLUTION

Inasmuch as the attempt has been made in several states to prohibit in tax-supported institutions the teaching of evolution as applied to man, and

Since it has been asserted that there is not a fact in the universe in support of this theory, that it is a "mere guess" which leading scientists are now abandoning, and that even the American Association for the Advancement of Science at its last meeting in Toronto, Canada, approved this revolt against evolution, and

Inasmuch as such statements have been given wide publicity through the press and are misleading public opinion on this subject,

Therefore, the council of the American Association for the Advancement of Science has thought it advisable to take formal action upon this matter, in order that there may be no ground for misunderstanding of the attitude of the association, which is one of the largest scientific bodies in the world, with a membership of more than 11,000 persons, including the American authorities in all branches of science. The following statement represents the position of the council with regard to the theory of evolution:

(1) The council of the association affirms that, so far as the scientific evidences of the evolution of plants and animals and man are concerned, there is no ground whatever for the assertion that these evidences constitute a "mere guess." No scientific generalization is more strongly supported by thoroughly tested evidences than is that of organic evolution.

(2) The council of the association affirms that the evidences in favor of the evolution of man are sufficient to convince every scientist of note in the world, and that these evidences are increasing in number and importance every year.

(3) The council of the association also affirms that the theory of evolution is one of the most potent of the great influences for good that have thus far entered into human experience; it has promoted the progress of knowl-

edge, it has fostered unprejudiced inquiry, and it has served as an invaluable aid in humanity's search for truth in many fields.

(4) The council of the association is convinced that any legislation attempting to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution would be a profound mistake, which could not fail to injure and retard the advancement of knowledge and of human welfare by denying the freedom of teaching and inquiry which is essential to all progress.

Evolution is itself an established fact of nature—*the* account, and the *only* account, of its almost unthinkably intricate story that satisfactorily explains to an intelligent mind the fact of our own existence.

To recapitulate briefly, then, we have found matter assuming an infinite variety of forms, and, parallel with the changing material structures, we have seen energy manifest itself in many forms—electric energy, magnetic energy, thermic energy, chemic energy and now biotic or life energy.

We found that electric and thermic and chemic and magnetic energy were very intimately related, and we also found that chemic and biotic energy were very intimately related. In fact, biotic energy arises directly out of chemic energy. We found that electric energy exists in various form, either as a static electric charge, or the flow of electrons through a

conductor and therefore electric current; that this current may be transformed into a very wide range of forms from very heavy amperage at low potential to the same amount of wattage at such a tremendously high potential that it leaps off into space from the radio broadcasting station and travels through the atmosphere with the velocity of light itself.

The exact parallel to this, and in absolute harmony with the principle of transformation of energy, occurs in the field of biology. We also find in the case of various forms of biotic energy that the lower forms are being transformed into higher biotic energy forms. Thus the simple life principle of the protoplasm acquires the new forms of energy that go by the name of the various senses of the plants which enable them to reach down into the soil and find the elements their chemic nature requires, to reach up into the air and lay hold of sunlight, to deal with the atmosphere and extract from it the elements the plant needs for its life and growth and further evolutionary development.

Then there are other biologic energy manifestations that it will be pertinent to consider here. Plant some seeds in a box in your basement and put them in a place where light can get at them from only one window. As soon as the sprouts rise above the surface of the soil, if they be plants that are accustomed to living in the sunlight, they will immediately all bend over and lean toward the window, reaching for the light. Turn the box one-quarter of a circle around and in a few days you will notice that the

sprouts have changed direction again and are still reaching for the window. After they have grown in this direction a little way, turn the box again, and again they will change direction to reach for the light. They will also grow much taller than they normally would in an effort to obtain sufficient light.

The plant has acquired an affinity urge for the light that impels it to expend large amounts of energy to get the light. The plant has acquired the ability to *do something* toward getting that which is needed for its growth, and so it makes its approaches toward this source of light. Biologists call this the phototactic sense.

Plant a trailing vine in your garden and set a stake off a few inches to one side. As the vine grows you will see it reach out after that stake and actually move over and clasp it. The plant is not assumed by scientists to *know* as we do, yet the point is that something within it enables it "to take care of itself."

Look how the young tender ends of your grape vines reach out for something to take hold of. They are groping for whatever support there may be in reach. Put something there for it to take hold of, a twig, a string, anything, and look at it again tomorrow. One of its delicate tendrils will have wrapped itself tightly around the new support and will hold it in a firm grip. Here is biotic energy displayed in a form curiously equal to knowing that the plant needs support, coupled with the ability to take hold of that which meets the need.

And in passing, consider the class of plant known

as insect feeders. One remarkable species is the pitcher plant. The leaf of this plant, as you may know, grows in the form of a pitcher, holds water which forms as dew on the heavy leaf and is led down into the pitcher by the hairy spines that grow on it. The leaf puts into this water a glutinous substance that attracts insects. The insect can easily find its way into the pitcher, but when it turns to go it finds ten thousand sharp-pointed spines directed toward it and escape is impossible. It ultimately drowns in the water, then the digestive juices, including pepsin, which the plant has put into the water, digest the insect and all but the refuse is absorbed into the plant.

Another remarkable variety is the one known as Venus Fly Trap. A portion of the leaf of this plant is very similar in shape to the ordinary sharp-toothed bear trap, but much more perfect in construction. When an unfortunate fly or insect crawls between the two jaws of the trap and touches certain hairs which are connected with the trigger, the muscles of the leaf suddenly spring the trap upon the insect, the sharp teeth or spines of the two jaws of the trap interlace with each other, making escape of the insect impossible. It is then digested and assimilated by the plant. The plant is rooted in the ground, yet it feeds on living prey.

A great number of similar instances might be cited, but these are sufficient to show how, if we look for them, we can see the first evidences of mind displayed in ordinary plant forms in various ways.

Who can be sure that Venus Fly Trap does not know what it is doing? Certainly there is a demonstration here of something we can call intelligence of a botanical order, and being on the botanical plane it is intelligence of a character we do not clearly comprehend.

Among the animals, biotic energy arises to still higher forms of capacity and we find them acting for their own welfare in ways which we say are directed by instinct. What instinct is man cannot fully explain, but certainly it is a low form of mentality. Instinct in the lower animal forms is related to instinct in the plant, although we are not in the habit of using the word instinct in connection with plant forms. Neither are we in the habit of using the word mind in connection with plant or the lower animal forms, for the words mind and mentality are reserved for the higher manifestations of this capacity to take care of itself displayed by the more advanced animals and man. Nevertheless, the connection and the relationship are there and clearly to be seen by all who are willing to look.

In the higher organic forms, throughout the animal world, we see this biologic energy built up and blossoming out into greatly varied and still more remarkable forms. In some of the microscopic animal forms, much too small to be seen at all by the unaided eye, under the microscope a tiny organism may be observed hunting about for its prey just as a wolf hunts for a rabbit; when it finds its prey it leaps upon it, destroys and devours it. Can we be

sure that there is not a form of intelligence displayed here? Through hours of study under the microscope these tiny organisms are seen to pursue their life courses with apparent intelligence.

Just so, on up through the higher animal forms, we see the presence of energy in the form of knowledge, of will, demonstrated by intelligent action, calculated to promote the best interest of the organism itself. Every activity of a human being, every thought, the emotions, the religious instinct, love, hate, the faculty of reason—all these are but energy manifestations that have their root and their explanation in the brain in co-operative relations with the various organs of the body, and the body as a whole. They are but added evidence of the continued operation of the fundamental law that atoms and molecules and colloid structures and protoplasmic cells tend to unite and produce larger and better developed organizations with a consequent parallel advance in the transformation of energy into new forms with more wonderful capacities for taking care of themselves.

This is the view of the biologist. But in order to arrive at this view, to which a multiplicity of unquestioned evidence inevitably leads, the biologist has had to consider and make allowance for the findings of the chemist and the physicist, the mathematician and the astronomer and the geologist. In fact, all the pertinent evidence—and this includes all established facts of the sciences which precede biology in the hierarchy of nature—points to this inevitable con-

clusion. Millions of facts, all in absolute harmony and not one established fact hostile to it, make the conclusion so positive, so unquestionable, that none but the uninformed or the illogical mind can fail to accept it.

Thus the general study of life by the biologist prepares the way for the study of the mind by the psychologist; for while this new phenomenon of mental energy is a thing that rises directly out of the fields of study of the biologist, he is no more competent to study it to the best advantage than the chemist is to study biology in general, or the physicist to study chemistry. Therefore the biologist must step aside and allow the specialist in the field of psychology to take up the discussion.

But let it be clear, there is no break in the chain. We find the beginnings of psychology in very low plant forms, and somewhat higher manifestations in some of the more complex plant forms. The psychological becomes an increasingly dominant characteristic of animal forms, until in the case of man his energy manifestations of a psychological character are the outstanding and striking feature that differentiates him from the other animals. In fact, this preponderance of mentality and a certain egotism which grew up with this consciousness of his superiority over other animals has in the past caused man to consider himself a thing apart from the balance of nature. It has led him to believe that to him, by some special process of creation denied to all the balance of nature, was given the superior position of

a god. Physiologically and anatomically, aside from the more perfect development of the brain and nervous system, man is but little more interesting or complex an organic structure than the horse. But in the mental sphere man is such a vastly superior creature that the setting off of the study of psychic energy as a special science in itself is fully justified.

But before leaving the subject of biology I ask the reader to recall the absolute harmony of the biologic laws of energy with all the other laws of energy previously discussed. Nowhere in biology is there violation of nature's principles in her other activities, nowhere is there the slightest suggestion of chaotic action by divine will. On the contrary, everywhere we observe law, order, harmony with the cosmos, Infinite Intelligence, and Energy engaged likewise in the performance of all these biotic functions.

CHAPTER VI

THE GEOLOGIST SPEAKS

Law, Order, Cosmos, God

In the physical history of the world the work of the geologist begins where the work of the astronomer ends. The astronomer and the astro-physicist account for the mass of material out of which worlds are made, the processes by which the material is brought together in a round mass, its relation to other worlds, how it is maintained in its position in space, and how and why it proceeds in orderly fashion about its business of rotation and revolution.

But there the work of the astronomer ends. It is the geologist who traces the further history of the earth from the time of the first accumulation into solid form of the minerals from which the earth is built up.

Geology begins, then, its physical history of the earth at the very remote period when the earth consisted only of those materials which are found in the oldest igneous rocks and minerals and the waters of the seas. In those days not a bit of flat, stratified rock existed on the earth. Relatively to the vast length of time that has passed while all the stratified rocks have been forming, that archean period, the

time before any sedimentary rocks were formed, was the early youth of our world. There was no soil as we know it today, no vegetation, no animal life. Only a more or less round, rocky, metallic mass, probably less solid than now, torn by volcanic and earthquake upheavals, the contending pressures at work slowly kneading the mass like dough.

But with the downpour of rain from the skies, the frosts of winter and the wearing of the winds and streams the primordial rocks were weathered away. Sediment was carried down by the streams and deposited in ocean beds. Thus were the first beds of silt laid from which the first stratified rocks were formed.

But the materials of which the earth is made do not maintain their relative position even when unaffected by erosion. The earth is subjected to certain twistings due to lack of homogeneity of its substance, lack of perfect balance in the immense rotating sphere, and lack of perfect sphericity, which cause strains in the rocks and metals of which it is composed. Other strains are also introduced by the gravitational attraction of other heavenly bodies, as well as by the immense pressure of the tides. These strains to which the earth has been subjected through all its past history have always tended to bring about, and are bringing about now, changes in the contour of the earth's surface. Occasionally the rocks are broken, certain areas sink to lower levels, while others are upheaved to a greater elevation.

Geological research proves that this action went on, also, in the very remote ages.

Certain areas on the earth's surface remained quiescent during sufficiently long periods for strata of rock to be formed from the sediment washed down by the streams. Later, as the surface of the earth was bent and broken and kneaded like dough, these strata were broken up, with the result that sedimentary rocks which formed in strata lying level or parallel with the earth's surface are today found standing on edge, at all angles and positions, some in curves, bent thus by the strains that they have undergone.

During these upheavals lava flows and ashes and cinders from terrific volcanic action buried deep some of the rock formations that had formerly been on the surface. These changes have gone on intermittently, as is clearly shown by geological research, through all the past hundreds of millions of years that our earth has been developing to its present status.

Each area on the earth has had its periods of quiescence and disturbance, and in all parts of the globe stratified rock has been found. Geological research has been pushed so earnestly and by such capable men during the past hundred years that the various layers of stratified rock in existence have been pretty well charted the world over. Furthermore, it is known with a very considerable degree of accuracy exactly in what order the various strata of rock were formed. When arranged in order from the oldest to

the latest, like successive chapters in a book, they tell a most instructive and interesting history of what took place on the earth long, long before man or any of the higher forms of life had made its appearance, as well as from that day to this.

The sediment that accumulates in the oceans and seas to form the stratified rock gathers slowly foot by foot, which means the layers of strata require for their formation considerable periods of time. The history of the earth embraces such vast eons of time that the stratified rocks total up a sum of something like thirty-two miles in thickness. The majority of these strata have been destroyed in most places, having been first upheaved, then worn down by erosion, glacial action, water and wind and again entirely obliterated except for bits that have happened to escape here and there. But take the surface of the earth the world over and sufficient of the stratified rock of all the geologic ages is left so that the orderly sequence is now quite well understood.

There are places along the Grand Canyon of the Colorado River where the sightseer may stand and at one glance of the eye see toward the bottom of the canyon the old igneous rock, solid granite, beneath the horizontal strata. For these old archean rocks are the foundation upon which the sediment settled and the stratified rocks were formed. Above the archean rocks at the bottom of the Grand Canyon the eye may see the stratified rocks lying in layers thousands of feet deep. These stratified layers were

at one time much higher in altitude, but the upper portion has been ground off and weathered away, leaving only the older stratified rock in place today. But the tourist who views the wonderful scene is looking upon the products of periods in the earth's history which are so exceedingly remote that we must estimate the time in hundreds of millions of years at least. Even when these stratified layers were forming on the old granite at the bottom of the sea the earth was already old, for it must have taken many millions of years to have reached that early point in its development.

There are various more or less satisfactory ways of calculating the interval of time that has passed since the formation of the archean rocks up to now—ways which need not be gone into here. Let it suffice to say that on the best evidence the date of the era of the archean rocks, before the first stratified rocks were formed, was from one thousand million to sixteen hundred million years ago.

In the sediment eroded from the rocks, vegetation, which probably originated in the seas or inland lakes, got a foothold. The chemistry of plant life produced new substances that mingled with the sand of the rocks and soil containing this vegetable mold in time covered large areas of the earth, a state of affairs of increasing assistance in the development and propagation of new forms of vegetable and animal life.

This, very briefly outlined, is the geological history of the earth. But even more pertinent and inter-

esting is the fact that the *history of life* on the earth runs exactly parallel with the history of the sedimentary rock growth, and that it is traceable in the sedimentary deposits the world over from the earliest strata formed down to the present day. But this is not strictly geology. Since it deals with life, this particular part of the history of the earth becomes the field of activity of the paleontologist.

But before leaving the subject let us note this: The science of geology proves the course of the development of the earth was an orderly process from the remotest ages down to the present day. Physical causes have gradually brought about these colossal physical results naturally. The astronomer has shown us that the birth of the earth took place as a result of the operation of natural law, *i. e.*, astronomical law. The geologist finds natural laws continued to operate and that they account fully for the development of the earth to its present status. These changes have not taken place on the earth by fiat or by chance. The earth is and always has been a part of an orderly cosmos. Development proceeds by law and order. The principle of cause and effect has ever been operative. Here, too, we find there is and always has been *Law, Order, Cosmos, Energy.*

CHAPTER VII

THE PALEONTOLOGIST SPEAKS

LAW, ORDER, COSMOS, GOD

The researches of the bio-chemist and the biologist show that life has its nest in chemic and colloid structures. In harmony with these findings, the geologist and paleontologist tell us that when the earth had reached the period of its development where chemic and temperature conditions on its surface were conducive to the development of biotic energy (life energy), life sprang into existence. Our studies have made it clear that as soon as the conditions were right for the production of a new form of energy anywhere in physics or chemistry, or what not, it *had* to appear. And since our best evidence indicates that no known form of life could exist at a temperature above 132 degrees Fahrenheit, except certain algae, on the earth's surface or in the seas, it would not be logical to expect evidences that life existed on the earth until its surface temperature was reduced below that point. This is borne out by the geological and paleontological evidence.

Furthermore, on the principles sanctioned by chemistry, bio-chemistry and biology we would expect to find evidences of only the very simpler

vegetable and animal forms in the oldest of the fossil-bearing strata. This is the logic of the principle that simpler forms always develop before the more complex. It cannot be otherwise. It is at the same time the actual fact, as shown by the examination of all the fossils found in the oldest rocks. In the oldest archean rocks on the earth only the blue-green algae, very primitive microscopic plants, have been found. Slightly more complex varieties are found in the earliest sedimentary rocks. Carried still further, the principle suggests that, as time went on and strata after strata of new rock formations were laid down in the following ages, higher and more complicated animal and vegetable forms are to be expected.

This is, indeed, the wondrous truth discovered by paleontologists. For in the very oldest of the sedimentary rocks which were deposited perhaps a thousand million years ago there are found today only the fossils of bacteria, of colloid structures, and of the very simple vegetable growths known as algae. In sediment deposited a little later very low animal forms are found. These plants and animals were buried in the sediment and have thus been preserved through the millions of years, *literal tablets of stone* which speak a wondrous but clear language, telling us of the life that existed on the earth in that very remote past.

As the paleontologist examines the higher and higher—which means the later and later—sedimentary rock formations, he observes three very perti-

nent things: 1. *New life forms* are found which are not found in the older rocks. 2. These life forms are of *increasing variety and of greater complexity.* 3. The simpler life forms found in the very earliest stratified rock *become scarcer and scarcer* and in a great many instances absolutely disappear.

Another important fact that the paleontologist observes is that in the case of those plants and animals that persist and are found in following ages *many of them have not stood still in the interval, but have undergone an adaptive change.* True, in some few instances, animals on the earth today seem to have changed very little from their kin which existed long ages ago. But these animals and plants happened to be so constituted that they could continue to live through changing conditions just as they were, without suffering any adaptive changes whatsoever themselves. However, these few cases are the exception. The conspicuously important finding of the paleontologist in this field is that *new animal forms come into existence* with the passing of time, increase in number and in the gradual perfecting of the organism and then with the passing of their era sink away into final extinction. This seems to be the natural law. We can see it operating today in the passing of numerous animal forms, many of which we would like to preserve, such as the American bison, the Alaska seal, the passenger pigeon (the last of which died recently), and the various other birds that are rapidly approaching the end. Dr. William

T. Hornaday, the famous ornithologist, says that twenty-three species of our native birds are now in danger of becoming extinct.

Furthermore, once a species has ceased to exist, with all his searching the paleontologist has never come across a bit of evidence to indicate that this species has ever existed again through all the hundreds of millions of years of paleontological history.

While the life energy operated in animals and plants of former ages as it does today, the species existing then were for the most part very different from those which are found on the earth now; and the further back in time we go the more primitive are the animal and plant structures and nearer their approach to the very low forms of life where not much variation is possible.

Now, if there is any one thing firmly established by the science of paleontology it is the fact that a great many species of animals once existed on the earth which have become extinct and never have existed again. This disappearance by extinction of many kinds of animals is traceable from the bottom all the way up through the various layers of stratified rock. The clear inference is that new animal forms must come into existence as time passes, else the earth would soon be depleted of all animal life.

This inference that new animal forms have developed from time to time is confirmed by the paleontological records, for the later strata contain many fossils never found in the older beds. The only reason human history contains no record of the actual birth

of new animal forms in nature is the great length of time which nature takes to bring about a change of species.

What nature takes so long to do by itself, now that man has come to understand the principle of life evolution, it is possible for him to induce nature to bring about under his direction in a comparatively short time. The production of *absolutely new species* of life has been achieved by Luther Burbank over and over again.[1] Working with varieties of plants which reproduce their kind in short time, by taking advantage of well-known principles of heredity, it is possible to create in a few years what unaided nature would take many millenniums in the way of development of new varieties and fresh species to achieve. As the hereditary principle operates no differently in animals than in plants, it follows that the development of new animal species can be brought about by man in exactly the same way. All the evidence goes to prove that new species are thus brought about in the ordinary process of nature, but the evolution then is so slow that it almost escapes our attention. It is only in the perspective supplied by a sufficient length of time, such as is obtained when viewing the facts laid out before us by paleontology, that we can see at a glance how new species have been developed from former species.

1 On this point there is much misinformation extant and much inaccurate comment being made. But Mr. Burbank assures me he has produced numerous absolutely new species which reproduce very true from seed year after year; that anyone can do this if he knows the technique and has the necessary patience.

Gathering up all the pertinent evidence, the evidence from colloid chemistry, from early biology, and the evidence paleontology finds in the fossil remains of plants and animals through all the geologic ages, the indications in regard to life are these: life first formed in water, in the sea or inland lakes; it has assumed myriads of different forms; long, long ages elapsed before animal forms reached that state of complexity where their bodily structures began to be built around back-boned skeletons; that these vertebrates succeeded one another in logical ascending order, first the fishes in the seas, then the amphibians living both in water and on land; then the reptiles, land animals for the most part, but able, also, to spend some of their time in the water; then the birds and mammals, and in this last class the primates; lastly, and highest of all, man.

These are the conclusions warranted by the evidences of all the sciences bearing upon the question. Chemistry, biology, zoology and anthropology lead directly and with unbroken steps up to the creation of the present human race, as their consummation, and geology and paleontology support this conclusion with unquestionable records.

Here again, then, from the amoeba to man, all that we find we also find has been produced by the operation of natural law. Causes plainly precede and effects plainly proceed from them every step of the way. This is nature's process of creation. All that has taken place is the result of a thousand and one steps taken in a logical, systematic order. In

other words, in the realm also of the paleontologist, we find *law, order, cosmos, Energy.*

But at this point in the study of the history of man begins the next higher branch of the general subject, which we treat as a separate science, named anthropology. Now, therefore, let us hear the anthropologist speak.

CHAPTER VIII

THE ANTHROPOLOGIST SPEAKS

Law, Order, Cosmos, God

Anthropology is the science of man. Its subject matter his origin; his physical, mental and moral make-up; the causes, course and history of his development from his earliest appearance to the present time; and his relation to other creatures that share with him the possession of biotic or life energy.

It begins with an examination of man himself. His structure is found to be made up of numerous organs, built around a bony framework, with muscles, nerves and a brain, through which blood circulates. He partakes of animal, vegetable and mineral food, digesting it by chemical means within his body, assimilating the useful elements and transforming them into biotic energy. Note that this description and these processes apply with equal accuracy to all vertebrate animals.

Some further fundamental features pertaining to man are these: 1, his body is made up of an enormous number of cells; 2, these cells group together and form organs of different characteristics; 3, provision is made for progeny and for mechanism of heredity whereby individual characteristics are

repeated, with variations, in the following generations; 4, the race is divided into two sexes; 5, sexual fertilization is the first step in the process of cell organization to form a new body after the general fashion of the parent bodies; 6, new organism, as it grows, grows in physical complexity accompanied by a growing complexity of psychic, instinctive, emotional and intellectual traits and abilities; 7, the entire organism ultimately suffers a breakdown, disintegrates, and all the manifestations of energy of which it has ever been capable vanish away.

Anthropology next conducts an inquiry to determine whether these fundamental features of our human structure are peculiar to the human race.

1. Is man the only structure composed of cells as its basic units? Ask the biologist, the botanist and the zoologist. They will all tell you that every living thing, vegetable and animal, is composed of cells and that these cells are essentially identical in nature with those which make up the human body. The investigator in this realm of nature soon becomes convinced that the life principle in man's bodily structure is identical with the life principle in the bodily structure of every blade of grass and of every tree and animal the world over.

Life energy possesses one and the same nature wherever it is found, just as electricity is the same kind of energy wherever found, or magnetism, or chemical affinity. It is true in regard to each of these forms of energy that there are varying degrees to its power and different angles and ways and methods

of the application of that power, so that they are none of them always perceived by our senses with the same readiness. Then, too, by the multiplication and transformation and the interplay of various energies an enormous variety of results becomes possible. This great variety of results has become actual in myriad vegetable forms, and the countless number of animal forms that populate the earth. But let this be kept clear: Life, wherever found, is life, one and the same; in its essential nature it is identical with all other life, whether it be life in man, in the beast of the field, in the fishes in the seas, in the rose in the garden or in the countless minute living forms that are only perceptible to us through the microscope.

The point to be emphasized here is this: The cell unit of life is always the same in its essential nature. This fundamental fact alone would indicate man's close relationship with all other living things. How could it be otherwise?

2. Are specialized organs built up from cells a peculiarity of man's bodily structure? The counterparts of all the organs of the human body are found in the near-related animals, and many of them in animals as distantly related as the birds, the reptiles, and the fishes. Their organs are built of cells the same as ours, and the chemic processes carried on within them both are practically identical.

3. What about the principle of heredity? Is this peculiar to man? While this question has its very fundamental and important religious bearings, the

correct answer is well known. The share of the principles of heredity in the making of human progeny is known to be identical with that exercised by them in the parentage of all plant and animal life. The student of plant culture—such, for instance, as Luther Burbank—can tell in advance with mathematical certainty what the results of the crossing of two strains will be. For that the law of heredity works out into a mathematical formula has been demonstrated over and over again, with various kinds of plants and animals and humans. It always applies to all alike. Man proves to be no exception to this mathematical law of heredity. He is treated by it no differently from every other animal and weed and flower.

At the same time the plant culturist and the animal breeder know well that the first great law of like from like in heredity is subject to a second mathematical law, the law of probability, which occasionally brings about mutations or departures from the scheduled results. Plants and animals are thus produced which are out of the ordinary, marked by some feature that makes them different from the great majority of the parent species. The operation of this same law in the making of human progeny brings about the mutations which we know as geniuses, musical or mathematical prodigies, eccentrics, and other pronounced variations from the more hereditarily regular.

Here again, then, the presence of this identical principle known as heredity, operating under its com-

plicated mathematical laws, in all plants and animals as well as in the human race, indicates the oneness of all life.

4. Consider now the next step which life takes for its own perpetuation. Is the process of reproduction by which the continuation of life energy is insured through succeeding ages any different in the case of man from that of the other animals and plants? You may go up and down through all the realm of zoology, study the answer given to this question by any living animal, gigantic or microscopic, take the testimony of the original protozoa, the very first and simplest animal forms, which sometimes consist of a single cell, and throughout the whole realm of animal life you will receive one and the same reply, the development of sex and sexual reproduction. There are variations in details, it is true, but there is no variation from the basic principle; and the variations in details are themselves in absolute harmony with, and in support of, the general principle of evolution. Here again, in the matter of reproduction and the perpetuation of species, the same basic principle applies to man as applies to all other animal forms. Man in this respect is a part of animal nature, not a thing apart; not different, but essentially one with the rest of the great group of animate life.

But the principle of sexual reproduction is even more fundamentally grounded, for it is the rule, also, throughout vegetable life. The flowers in our gardens, the grains in our fields, the grasses, the trees,

all forms of vegetable life have well-developed sex organs which perform the functions of reproducing their kind in harmony with natural laws for the perpetuation of the species. Here again we find a fundamental aspect of man's bodily structure to be identical with that of even the low forms of vegetable life. And nowhere in it all has there been need to resort to fiat, to any violation of natural law, but all these proceedings have been carried out in beautiful harmony with established principles. New generations continue to be brought into existence, to unfold and in their turn to reproduce their kind again in a way that is perfectly *lawful, orderly* and in harmony with the great *cosmos* and with *Divinity.*

5. In man as in other animals, and as in the flowers and grain and grasses and trees, following the sexual fertilization of the ovule a certain creative energy begins its operations, with the result that there is soon produced a vast accumulation of new cells. The same creative energy soon takes steps to group these new cells into organs and the final result is an entire new specimen of the particular species, partaking of the characteristics of the two parent sides. The operating principle in this process is the same throughout all the realm of botany, and zoology, including man. A brief description of what takes place in one case might very well serve as a description of the same process in another species; and while the finished product may present very wide differences there is no essential difference in the creative principle employed. Here again man is

found to be a brother of the beast, the fish, the plant; in short, all living things.

6. How do things stand if the comparison be made on the basis of mentality, which we like to say differentiates man from the lower animals? Man does rank vastly higher in brain power, in what we call the moral sense, and in the faculty of reason. We would like to go on to a belief that his mentality entirely separates man from all the rest of creation and proves him to be a specially favored creature of the Almighty. But is there any sound basis on which to hold this belief? What say the facts?

A study of man and animals from this point of view reveals exactly what the logic of our previous findings should lead us to expect. We find that the mental traits of animals are essentially identical at a great many points with those of man. Psychologists well know that practically all of the life of the average human is controlled by instincts and emotions possessed by him in common with the higher animals, and that the higher faculty of reason cannot be depended upon to influence them appreciably. It is in the higher faculties themselves only that man is different from the beast of the field and the forest. It is true that this difference exists, but, like the human thumb, it is a difference not made out of whole cloth, but due to man's carrying their common mental potentialities some steps beyond that attained by the other animals. His mental precedence is a natural result of the higher and more complex organ-

ization to which he has carried his brain and nervous system.

Accordingly, from a scientific point of view there is no warrant for the statement that the mind of man entirely separates him from the animals. On the other hand, it is those who have most carefully compared the psychology of man and animals who understand most clearly how good an illustration his psychic nature is of his relation to the other primates.

7. And finally, the vanishing of life energy on the breakdown of the organization of cells which compose the human body is true of every animal that ever lived, and of every plant of every kind. The death process is the same process, whether the subject be a human, a chimpanzee, a horse, a fish, a cabbage, one of the microscopic bacteria, or any other living thing. When the organization which is the vehicle of the manifestations of life energy breaks down and no longer exists, life and its various energy manifestations completely disappear.

Thus we are brought by our consideration one by one of the essentials of the life stream to the conclusion that man is not essentially different from any other living thing. What has been said as to cellular structure, the mechanism of heredity, sexual reproduction, the growth process that goes on in the new organism, the energy manifestations that the mature plant or animal displays, and finally death itself, applies to one kind of living thing as accurately as to another, so far as basic principles are concerned.

The science of man is most intimately linked with the science of all living things; for just as biology rests on chemistry as a foundation, and botany and zoology on biology, so anthropology grows up out of zoology without the slightest break in the chain. Therefore any creed or philosophy which attempts to explain the presence of man on earth should harmonize not only with these established facts of anthropology; but agree also with the truths of zoology, botany, biology, chemistry, paleontology and geology.

If the previous evidence is not convincing enough, plenty of other considerations can be cited to show that man's bodily structure is closely similar to that of the beasts. The human skeleton checks off bone for bone, in nearly all cases, with the skeleton of the ape, the horse, the dog, the bear and a great number of other animals. Even in the flipper of the whale you will find the shoulder blade, the humerus, the radius and the ulna, as well as the bones of the hand. The wing bones of the chicken display the counterpart of the human shoulder blade as well as the humerus, the radius, the ulna and a part of the finger bones.

Even the minutest peculiarities in the structure of human bones find their counterparts in the higher apes. In the case of the particular locations of the openings in the human bones through which blood vessels pass the same openings occur in the same positions in the bones of the chimpanzee.

Evidence of the same import is furnished by the

eye. Nature's first successful experiment in eyes that could be focussed was made with fishes. In the fish the crystalline lens is spherical, and the eye is brought into focus by moving the lens bodily backward or forward in the liquid of the eyeball. This method of focussing has its faults and its range is limited.

In the next higher grade animals, the amphibians, the eyes are still fishlike ones. In the next step higher, the reptiles, a ciliary muscle has been developed, which focusses the eye by changing the shape of the crystalline lens.

The eyes of all mammals make use of the most improved method and focus by changing the *shape* of the crystalline lens and not its position. In this respect the eyes of all land animals are similar to the human eye.

Some people grant everything else, but take a determined stand that the brain of man makes him different enough to separate him sharply from the balance of creation. It will be pertinent, then, to consider how man compares in brain structure with other animals. Such comparison of the brains of animals and man shows at once that the same outstanding features are found in them all: 1, a cerebrum; 2, a cerebellum; 3, an attached spinal cord, and 4, certain structures that bind all these together. At first glance it can be seen that they all are built after the same general plan.

Moreover, the similarity goes much further. The next most striking feature of the structure of

brain is the convolutions which mark its surface. Let it be noted here, then, that the principal fissures and convolutions in the brain of man are also found in the brain of the chimpanzee, the orang, the dog, the horse and other animals.

In the brain of man and of other animals there is a certain fissure known as the fissure of Rolando. Experiments on cats, dogs and other animals have demonstrated that around this fissure are located the nerve centers which control the muscles of different portions of the body. The exact locations of these different muscle nerve centers in the brain have been definitely determined by experiments on animals, and all these motor centers of the brain are now well charted. Excitation of any one of these spots will produce muscular contraction in a particular part of the body. For instance, a stimulus applied to a certain motor center in the brain will produce a movement of the leg; excitement of another center will produce movement of the arm; prodding another will produce motion of the muscles of the face, etc. As often as the one spot is touched, the set of muscles responding is always the same.

Now it has been demonstrated that these same motor centers occur and are located in the human brain in exactly the same positions as in that of the lower animals. In fact, brain specialists take advantage of this knowledge where external symptoms indicate an abnormal condition in the brain and the surgeon knows exactly what portion of the skull to open in order to get at the seat of the trouble. But

that knowledge was acquired, not by experiments on human beings, but on lower animals.

Now the pertinent thing to remember is that the motor centers in the human brain are grouped around the fissure of Rolando exactly in the same positions as they are in that of the lower animals. The immense significance of these facts is so obvious as to require no further comment here.

Again: Everyone knows that the adult human heart consists of four cavities and that these cavities contract and pump the blood through the arteries, capillaries and veins. The method of doing so is the same in animals as in man. But there is also a wonderful bit of mechanism in the heart, a group of muscular fibers known as the bundle of His, which times the contraction of the auricles and ventricles; for those cavities must be expanded and contracted in regular and proper succession if the engine is to continue to work right. Sometimes, instead of the cavities contracting in the regular 1, 2, 3, 4 order, an injury to the bundle of His causes some of the cavities to contract out of order, and the succession may be 2, 4, 3, 1. Every automobile owner knows what would happen to his motor under these circumstances and that an accurate and dependable timing system must be maintained or a motor engine will break down. When this happens to the heart death follows.

This bundle of His is exactly such a timing system. It contracts the four cavities of the heart in proper order, a beautifully complicated, necessary

and efficient bit of mechanism which continues to work on without giving any trouble, usually throughout the entire span of life.

But the pertinent thing so far as this volume is concerned is that this same bundle of His is also found in control of the timing of the heart engine, in all vertebrate animals. The bundle of His in the heart of man, in the chimpanzee, the horse, the fish, the frog, the birds, works after exactly the same principle. Does not this indicate some family likeness?

The processes of nourishment in the human animal consisting of the taking of food, the chemistry of digestion, the changes that take place in such organs as the liver, the stomach and the intestines, the assimilation through the medium of the blood stream as a carrier, the transformation of fuel energy into other energy forms, the basic principle of metabolism throughout the entire body as well as the elimination of waste—all these are the same in man as in all other animals.

A good deal has been learned in these recent years about the influence of the ductless glands. The thyroid gland, the adrenal glands and some others are known to exert definite beneficial effects upon body and mind, and physicians are now using these glands successfully in the treatment of a number of pathological conditions. Where do they get the glands for this purpose? In some cases, it is not even necessary to have human glands. For diseases arising from deficient action of the thyroid

gland in the neck the method is to use the thyroid from the lowly sheep. Please note the fact that it is not necessary even to take the gland from an animal of the same zoological order as man. Instead of using the organ from one of the primates we may successfully use the same gland from one of the far distantly related order of ruminants.

Of course there are degrees of similarity between man's bodily structure and that of the animals—some nearer, some farther, and on this point science is not without its evidence. It has found that only one class of animals, the chimpanzee, has blood of a character sufficiently similar to that of human blood to be safely transfused into human veins. When the blood of the chimpanzee is mingled with human blood practically no chemical reaction takes place, and the transfused blood may go on functioning normally as if it rightly belonged to that individual. But between the blood of man and that of other animals there is a slight chemical difference, with the result that when they mingle there is a slight chemical reaction. These facts seem to indicate clearly how close is the similarity that exists between man's bodily structure and that of the other species of primates; particularly so in view of the fact that the same conclusion is supported by a vast amount of other pertinent evidence.

If still further anatomical and physiological facts bearing on the point at issue are desired, embryology will furnish them. Throughout nearly the entire nine months history of the human embryo its

development runs parallel with that of the embryo of the anthropoid apes. But the testimony of embryology goes much further. The human embryo repeats in most striking fashion the various successive stages in the course of the evolution of all life leading up to man.

The human embryo begins as a single cell, an egg, fertilized by contact with one of the opposite sex, exactly the same as all the plants, the microscopic protozoa, and all other animals. This means that in the beginning the human is a one-celled animal, a protozoan, but with a mysterious capacity for higher development. In time a pulsating tube containing blood makes its appearance in the embryo, a one-chambered heart, similar to that of the worm.

Later this heart tube develops another chamber, it becomes a two-cavity heart, the fountain of a circulation like that of a fish. At from three to five weeks of age, gill-slits occur in the sides of the neck and the organism is equipped to breathe by this means. It also has a cartillagenous backbone. The embryo of all animals ranking above the fish zoologically have these gill-slits and backbone appear at the same time as they do in the human embryo. As the gill-slits are useless to air breathing animals, they later disappear, though leaving rudimentary traces; the backbone, being useful, is subject to more and higher developments. At this stage the human embryo has passed from the status of the protozoan to the status of the embryo of a fish.

The next remarkable stage which follows is marked by the beginning of the development of the lungs, the first forms of which correspond exactly with the air bladders of fishes. Then comes the formation of another chamber in the heart, by which it becomes three-chambered like that of a frog. The embryo has now advanced one stage higher.

The heart next undergoes another change, in which it shows signs of the beginning of a fourth chamber. Its status with this feature added to other changes that have taken place, is now identical with the similar stage arrived at by the embryo of the reptiles. Later on the heart further develops into a heart with four complete cavities. The other organs, like the similar organs of all the mammals become more highly perfected, the process continuing to the end of the nine months' period as in all the species embraced in the order of primates.

Again, at one period in its development the human embryo has a tail projecting from the body, longer than the legs and movable. Cases have been known where external tails still existed after birth.

Another remarkable evidence of the evolution of human life in the human embryo and those of the other higher animals occurs in connection with the development of the kidneys. At that stage of embryonic development which corresponds to that of the fish a pair of kidneys is present; at the stage afterward which corresponds to that of the amphibian or reptiles another pair of kidneys grows.

At a still later stage where the mammalian characteristics put in an appearance, a third pair of kidneys develop. This third pair is the permanent pair, in man and all mammals, the former two pairs disappearing before birth.

At the age of six months the human foetus is covered with long hair, all except the palms of the hands and the soles of the feet. At this period it is quite similar to the foetus of the orang, the chimpanzee, or the gorilla. At a certain time also in the prenatal development of the human ear, it is pointed and resembles the ear of certain anthropoids.

The human embryo at one stage possesses a thirteenth pair of ribs like the lower animals. A rudimentary thirteenth pair of ribs is still found in the anthropoids, though they disappear from the structure of the human foetus before birth.

As stage after stage of evolutionary advancement is reached, the development of physical structures not required by the higher organism ceases. In the case of the human embryo, by the time it becomes mature it has become a veritable museum of relics—of rudimentary vestiges inherited from prehuman life. Examples of these are found in all the higher animals. Over one hundred such useless relics have been found in the human body. One of the best known of them is the vermiform appendix. In this same useless, rudimentary form it is present only in the anthropoid apes and in certain rodents besides man. Other well-known vestiges are the

scalp muscles which some men can move; and the stump of a tail with caudal bones and muscles.

Thus the human embryo affords a clear demonstration of the principle that every creature before birth recapitulates the evolutionary history of the race to which its parents belong. In the case of the human embryo, the stage of the protozoan is dropped for that of the invertebrate; the invertebrate for the fish; the fish for the reptile; the reptile for the mammal; the mammal for the primate; and finally the primate for man, in orderly sequence and in beautiful harmony with, and fulfillment of, the biologic law of recapitulation.

But the principle of recapitulation is not yet done, for it continues in operation after birth. True to the same law are many characteristic experiences, also, in the realm of the psychic. The new-born babe exhibits only the beginnings of even the lowest instincts. The nerves of its lips are developed sufficiently for it to extract from the breast of its mother the nourishment needed for the preservation of its life, "the first law of nature." For the present it matters little that it neither sees nor hears nor thinks.

But it has an inborn capacity for growth, and in a few weeks, if all goes well, it begins to exhibit some additional, yet relatively low, animal instincts, such as curiosity. It is much interested in bright colors. So are fish, and the angler takes advantage of the fact. The animal instinct of fear also early

makes its presence manifest, but it does so even in animals very low in the scale.

One by one in their turn the other instincts and emotions unfold. Do boys get into fights? It is just as natural for them to let the pugnacious animal spirit take the center of the stage as it is for them to strive for food, or to shrink from injury, or to preserve life. The animal nature has developed full strength; not so the higher intellect that would teach him that fist fighting is not a very creditable form of exertion.

In early years the boy becomes a hunter, at heart if not in reality. At the behest of the cruelty of his animal nature which is apt to display itself at this time unless he is watched, the hunter instinct in the boy may impel him to destroy harmless and even useful birds and animals, without pity or compunction. The boy is cruel by nature, for boy and savage are two of a kind, with animal instincts in control. He is not like a savage, but actually a savage.

As time goes on, the mind develops and reason and intellect make their appearance, the baser instincts and emotions are to an extent subdued, the boy becomes a man, and acts the part of a human. But we all know, too, too well, how much of the cruel and selfish old animal nature is still scarcely dormant in all mankind and how little it sometimes takes to rouse it.

These are but a few of the anatomical, physiological and psychological evidences of the close relationships between man and the animals. How ex-

plain these identical organs, occupying the same relative locations within the body, operating in identical ways, subject to the same diseases, all the many points of similarity? Heredity, blood relationship, at once explains it all. There is no other explanation acceptable to any scientist. But in the light of heredity and evolution the evidence is clear. Man and the other animals have gone to the same school and been subject to the same instruction. The differences between them are due to the fact that man has been the better pupil.

Thus heredity brings to and bestows upon man his entire human and prehuman pedigree.

Now the science of anthropology, the science of man, may address itself to inquiries along other lines. And it is quite natural here for the question to arise, "What are the scientific evidences as to the time when man first appeared on the earth?"

On this question the geologist and the paleontologist speak up promptly and offer very pertinent evidence. They have discovered in rocks that are known to have been formed in the earth hundreds of thousands of years ago the fossil remains of prehistoric men. These fossil remains may be viewed today by the doubter. Of course in this book nothing but the briefest outline of the fossiliferous history of man can be given, yet this phase of the subject is so much to the point and the data so irresistibly convincing, that a few of its outstanding features will be in place. Consider the following:

Australopithecus Africanus. There was recently

discovered in South Africa the skull of a creature that was given this name, which means South African Ape. It was found in solid limestone, fifty feet below the surface of the earth, a deposit believed to be more than half a million years old.

The jaw, chin and teeth indicate a creature perhaps midway between the typical ape and the typical human, and the position of the foramen magnum shows that it walked in a more erect posture than do the modern apes, while the brain capacity is greater than in the gorilla.

High authority states that *Australopithecus,* though ape-like, had advanced far above modern anthropoids and that it was a logical connecting link between man and his simian ancestors.

Pithecanthropus Erectus. More than thirty years ago there was discovered in the Island of Java, buried under several different ancient stratified layers and more than forty-five feet below the surface of the ground, part of the fossil remains of a prehistoric creature. Upon first examination some authorities thought these bones were not human but were those of an ape. Upon further study, measurement and comparison, it is now quite well agreed among anthropologists that this creature walked fully erect as man does. The structure of the thigh bones proves it. Furthermore, his height was about 5 feet 7 inches, slightly less than our average height. But his cranial capacity was quite small, the estimates varying from 710 to 1060 cubic centimeters, while the brain capacity of modern man is from

1,000 to 2,000 cubic centimeters. Here, then, we have stumbled upon the remains of a man who once walked erect, of slightly less than average human stature today, but decidedly lower in intellectual capacity. Aside from *Australopithecus Africanus* this is probably the most ancient human fossil ever discovered, and the one showing the least brain development.

Along with the fossil human in the same geological deposit there was found the fossil remains of twenty-four or more other mammals, animals that lived along with Pithecanthropus. But note this: *All the fossil remains that were found along with these human bones belong to animals that have now long been extinct.* As new specimens do not quickly rise, nor quickly become extinct, the fact that all these twenty-four are extinct proves that Pithecanthropus dates from a very, very remote time.

All these bones, human and otherwise, therefore, belong to so ancient a time, a prehistoric age so exceedingly remote that the 6,000 years which theological authority allows for the history of the earth is not enough even to make a start on the back trail toward the beginnings of the science of man. For it is now agreed that Pithecanthropus lived away back in the Pliocene age, probably 500,000 years ago. And let it be noted here that as he was an erect, fully developed creature at that time, it had taken other hundreds of thousands of years previously for life to have attained that high development.

The Heidelberg Man. About sixteen years ago there was discovered in southern Germany a part of the fossil remains of another prehistoric individual, buried about seventy-nine feet below the surface of the soil.

This proved to be such a perfect specimen, so well preserved, its location in the geologic deposit so well authenticated and the nature of the deposits above so clearly defined, that all anthropologists who have studied this specimen are agreed in their conclusions concerning it. It belonged to another prehistoric race of men. These men were ape-like in many ways, though undoubtedly of a higher and more nearly modern development than Pithecanthropus. This ancient Heidelberg race had attained some considerable degree of intelligence. They were able to produce fire, they made tools of stone, they buried their dead, they were not devoid of all religious belief, and they believed in immortality as is evidenced by their burials.

Although the best authorities do not believe that the Heidelberg race was the direct forerunner of any human beings living today, yet were they living we would recognize them as human. They were a promising branch of the great order of Primates which apparently after reaching its culmination and highest development in the race which followed them, the Neanderthals, then became extinct. It is believed that the human beings in existence today arose not from this stock, but from other species of the same general order.

Taking into consideration the location where this fossil was found, the nature of the geologic deposit above and surrounding it, the other fossil remains found therewith and all the rest of the data bearing upon the matter, geologists, paleontologists and anthropologists believe that this race of Heidelberg men occupied that portion of Europe probably 400,000 years ago.

The Piltdown Man. Another ancient fossil discovered in Europe, this time in England, is that known as the Piltdown Man. In fact, two of these specimens, similar in character, were found. These possess exceeding interest for anthropologists, because the characters written out in them and clearly preserved to this day are a most peculiar mixture of the ape and the human.

Along with these fossils, very simple, crude stone implements were found; *also the bones of a number of other animals that have now long been totally extinct.* The authorities agree that this race of men lived in the British Isles, or what is now the British Isles, probably 200,000 to 300,000 years ago.

The Neanderthal Race. Of this race of humans quite a number of fossil remains have been uncovered and a good deal is known, although the race is believed to be totally extinct now. There are evidences that the Neanderthals were the successors of the Heidelberg race, in point of time and hereditarily. The Neanderthals had comparatively large brain capacity. They made flint tools, knew how to

make fire, had religious beliefs and ceremonies and believed in immortality.

The peculiarities of the skeleton of the Neanderthal race show that they did not stand fully erect, the head instead of being poised on the top of the spinal column was thrust forward in a brutish, animal-like fashion, and the thumb of the hand could not be opposed to the separate fingers as readily as in modern man. All summed up, the evidences are that while the Neanderthal man had a relatively large brain capacity, he was a bent-over shuffling, brutish sort of man below average human stature but of great animal strength. Sir Arthur Keith, one of the world's foremost anthropologists, says that the Neanderthal race displayed certain characteristics which were distinctly simian, but that other of their peculiarities could not be called ape-like, and these were confined to this one particular race.

The Neanderthals belong to a period of approximately 50,000 years ago. As a race, the anthropologists agree, they are extinct. At the same time, Neanderthal peculiarities occasionally crop out in certain human strains that are found in local spots in Europe. The right conclusion appears to be that the little Neanderthal blood that remains today is mixed with other strains so that the true Neanderthal is forever a thing of the past.

The Cro-Magnon Race. The Cro-Magnons were a remarkable race that lived in Europe about 25,000 years ago. They are believed to have been true representatives of *homo sapiens,* and the forerunners

of the human race of this time. These people were giants in stature, the average height being about 6 feet 4½ inches. The skull was large, averaging about 180 cubic centimeters larger than that of twentieth century man. The body was erect and finely formed. All told, they were a superior race of man, anatomically. It is also known that they had acquired a comparatively high degree of artistic development, for drawings in colors done by them have been found in certain mountain caves in southern Europe. They knew something of painting, engraving and sculpture, but their most important tools were still made of flint. From an anatomical or physical point of view it is doubtful if any race of men on the earth today is as finely developed as were the Cro-Magnons, but from the point of view of intellectual advancement and accumulation of knowledge, we would today still look upon them at best as a semi-civilized people.

Other types of humans or semi-humans have lived in the past, and we all know something of the range of the savages, barbarians, semi-civilized and civilized races, so-called, that are found on the earth today. Mr. H. M. Tichenor, in discussing the characteristics of certain bushmen of Africa, says: "The chimpanzee, living in the tropical forest zone of Africa, and the Basjesmans (bushmen) exhibit a far closer relationship than appears between the Basjesmans and the Caucasian."

In our own country, there were the basket weavers of Grand Gulch, Utah, possessing a degree of

civilization, thousands of years ago; the ancient Pueblos of our western states; the Aztecs of New Mexico; and the ancient civilization of Yucatan, where even now our archeological research parties are uncovering ancient cities, long buried in tropic swamps.

All these considerations, with the very wide variations in the human species from almost ape-like savages that are about as hard to tame as the orang, up to the so-called civilized and educated races, clearly show the long, long history that led up to man and the explanation of the animal factors in his present nature.

Geology and paleontology unveil to us the history of life on the earth for a period running back into hundreds of millions of years. Through past ages, enormously long, in which myriad living forms abounded in land and sea and air, no man existed on the earth. The age of man, which is now computed to be at least half a million years in length, is relatively so short in comparison with the milleniums that life in other forms has existed, that it is but a tiny fraction of the entire span that the earth has been the home of life. For the sake of comparison, let the period during which it is known that life in various forms has existed on the earth be represented by one year, and the time since man arrived on the scene would be represented by the last four hours.

Preceding ages have been remarkable for the predominance of certain types of animals. There was

once an age of fishes, then an age of reptiles, then an age of mammals; the last half million years has been the age of man. During that half million years it is known to the anthropologist that more than one race of men has had its day and ceased to be. New races have risen from obscure beginnings, spent long eras of life on earth, then ceased to exist, leaving only their fossiliferous remains for modern man to find. Down through the long, long avenue of the years they come—the races of Australopithicus, Pithecanthropus, the Heidelbergs, the Neanderthals, the Cro-Magnons, and others—all of whom perished and left the earth to new strains of the *genus homo* which rose and fell in their turn.

Following the Cro-Magnons, or the last of the great vanished races, historic times also have watched the continued rise and fall of races, tribes and nations. They have witnessed the splendor of the ancient civilizations of the Chaldeans, now gone forever; the rise and fall of the Babylonian civilization; the growth and decay of ancient Egypt; "the glory that was Greece, and the grandeur that was Rome." We may observe the same process still going on in this very day, nations and races of people rising to strength and dominating power, succeeded by a struggle to exist at all, and sooner or later the ultimate fall.

Of all these older civilizations that have ceased to exist, there is no evidence that any one of them had ever acquired the vast accumulation of knowledge that the present generation enjoys, which

enables us to trace the history of man as we do today. Will that advantage enable this race and this civilization to last?

Not much encouragement that it will can be found in history, for all that is known of man through the past half million years is knowledge of the repeated rise and fall of races. There has been no exception. It seems to be a law of nature. Human races rise, come to the front, fall and become extinct, for all the world the same as the thousands of extinct species of other animals that will never exist again. The likelihood that our present civilization can ever be submerged and our posterity return to barbarism, savagery and extinction is difficult for us to understand. Nevertheless, that is the logical destiny of the present human race, unless great masses of human beings now living can learn the lessons of individual, national, international and cosmic co-operation. Whether that is possible of accomplishment is the great question that is being tested the world over today. The riddle to solve is whether the present human race has reached that stage of intellectual development and understanding of natural laws that it can succeed where ten thousand other races and species have failed at this same game of self-perpetuation. In other words, will our present generation, our present civilization, fail to stem this historical tide, suffer a fall and go to destruction as thousands of other species have done in the past? Or have we acquired sufficient understanding and resolution in our trustee-

ship of the affairs of the race to devise and institute adequate measures to promote and insure its future? This is a consummation "devoutly to be wished," but one, also, of whose realization there is grave doubt.

As you meditate on how governments can go to smash and civilization perish, when you read of anarchistic and socialistic ambitions and propaganda in Russia and other European countries, and even in America, compare the following, written by Apuur, an Egyptian, about 3500 B. C., when the Egyptian civilization of that period was in jeopardy:

> The honest man is grieved because of what had happened in the country. Men who go out to play take their shields with them. The Nile had flooded the fields, but few went out to play. Poor men had obtained valuable goods. The slaves are sad, and the nobles no longer participate in the rejoicing of the people. The gentle-folk weep, the simple folks are glad, and the people from every town say: "Come, let us blot out those who have power and possessions among us." The river is blood, and men drink it. The boats of the people of the South have failed to arrive, the towns are destroyed, and Upper Egypt is a desert. A gentleman cannot be distinguished from the common man. Noble ladies and slave girls suffer alike, and the children of princes are dashed against the walls.

> The laws of the court-house are rejected, men trample on them in public, and the poor break them in the street. Things are now done that never were done before, for a party of miserable men have removed the king. Men resemble mud birds, filth is everywhere, and everybody is clothed in dirty garments.

Physically there is much evidence which goes to show that the man of today has passed the pinnacle of perfection and has already suffered a good deal of retrogression. Unless he can, in the mass, check these retrograde tendencies by compliance with the natural laws that will bring about better physical development, better mental development, better physical and mental heredity, and above all a sounder moral integrity, there is no future worth having in sight for the present human race. To get the appallingly necessary understanding of this situation into the minds of a sufficient majority, and to follow that up by inducing them to undertake a sane application of the natural laws that will avert such a calamity, is almost more than we can reasonably hope to do. It is a task which would tax the organized strength and immense resources of the Christian Church to the limit.

Some new Cato should ring the changes on the outstanding fact, which the whole science of anthropology brings emphatically to our attention, that through the ages past man has suffered the vicissitudes of misfortune in exactly the same way as have

all the other animal species. Not one of the various branches of the human race that have reached more or less highly developed stages of culture, has ever been able to insure either the permanency of its civilization or its mere existence. There is no evidence at hand that our present race and civilization are to be an exception to the same natural law. In fact, it would be something unprecedented if our present human stock should prove an exception to all the past history of life on the earth, by succeeding in forever perpetuating the life of its species. This would certainly entitle the men of this stock to be called miracle men. We would like to believe it true of them, but of this there can be no real assurance at present.

Reviewing then, the entire domain of anthropology, the evidence indicates that all life is related; that very early in the history of life on the earth biotic energy came to a fork in the road and thereafter operated along two different paths, with those great divisions as a result which we know as the vegetable and the animal kingdoms. The dividing line between plant and animal in the beginning is obscure. But with the passing of time the fissure of separation widens until in the later development and evolution of animal and plant species the separation is quite extreme. But nowhere through it all does the nature of the original cell undergo change. The cell in the brain of man in its essential characteristics is similar to the cell in any plant.

Anthropology shows by ten thousand bits of evi-

dence that man must be catalogued in the *animal kingdom;* his structure proves his likeness to the vertebrates; that he belongs to the class of *mammals;* that among the mammals he belongs to the order of *primates;* that as a primate he belongs in the genus *homo;* that as a homo he belongs to the species *sapiens;* and that this species is represented by 26 *races.* I will leave it to the reader to determine to which race, nation, tribe and cult he himself belongs; but by reason of his race, species, genus, order, class, division and kingdom he is related in bodily structure to all other living things. This conclusion is supported by many thousand pieces of evidence. There is no evidence to the contrary.

Any person who will take a minimum amount of trouble to think, observe, or read on the subject, may know for himself that man is related in bodily structure to all living things. We are part and parcel of the rest of life on the earth, plant and animal; more closely related to the animal, yet an animal life which at its root is related to plant life. The laws of life for the life of man are the laws of life for the life of the other animals. Human protoplasm is not different essentially from the protoplasm of the horse, the fish, the amoeba or the rose. The life principle is essentially the same wherever found throughout all living creatures.

That man is the highest and finest product of creation we may readily admit, the basis for the admission being his intellectual acumen. But that should give men living today no title to pride, for

they have had nothing to do with bringing it about. Judged on other bases man may be considered much inferior to the animals. In range of habitat he may be considered outclassed by the much despised rat, or by the English sparrow, for they, with nothing but instinct to guide them, can live and thrive under all sorts of conditions over a vast portion of the earth, and are probably the most efficient animals in existence. Again, on the basis of physical beauty, what man would wish himself compared with the pansy, the lily or the rose, or the thousands of other beautiful flowers that nature has produced for the perpetuation of the species to which they belong? Even the moth and the ant and the bee have to be credited with peculiarities of development which so far surpass the parallel abilities of man that we give the insects credit for having sense that man does not possess. So as soon as we say that man is the supreme creation we must at once begin to qualify that statement.

But with the necessary qualifications subtracted, we may permit ourselves the satisfaction of thinking that man is the supreme creature. If we be true to ourselves, however, we must admit the close relationship of man's bodily structure to the balance of nature even as all the pertinent facts of science declare, a few of which are here presented.

In this connection, in justice to one of the World's foremost scientists, Prof. William Bateson, who has been shamefully misquoted, I want to present here the following from his pen:

> "Let us proclaim in precise and unmistakable language that our faith in evolution is unshaken. Every available line of argument converges on this inevitable conclusion."

This view is the one accepted without question by all scientists, and we may say it is the one adopted by most educated people whose minds are capable of rising above their emotional prejudices. The facts as they have been brought out by our excursions into physics, chemistry, biology, paleontology, anthropology and physiology all demonstrate clearly that evolution is the process of the creation of man. This is the logical process, the process which is the most believable, the one plainly pointed out by all the pertinent evidence.

In short, in the perspective of an all-inclusive view of the whole process of creation and evolutionary development, we perceive that it is all full of signs that *law, order, cosmos, Supreme Intelligence, and Energy* are the sufficient explanation of this whole higher development.

CHAPTER IX

THE PSYCHOLOGIST SPEAKS

Law, Order, Cosmos, God

From the simplest atom up to the body and brain of man we have seen that increasing complexity of structure is accompanied by the birth of new forms of energy. The energy of the complex atom has very different ways of manifesting itself from the energy of the simple atom; chemical combinations manifest their energy in ways not exhibited by the atoms of which they are composed. In the colloid structures, next in increasing complexity, we found energy superior to that of the atom or the chemical compound; the beginnings of the processes of assimilation, elimination and growth.

In the simplest atom we find the energy impounded to be electric by nature; after that as we go up the line comes chemic energy, biotic energy and now psychic energy.

Psychic energy can not demonstrate its existence, and does not in the absence of the peculiar cellular structure found in the brain and nerve system of the animal, any more than chemical energy can demonstrate its existence except where elements are

brought together which possess some chemical affinity for one another.

Now the beginnings of psychic energy lie far back in the history of man and his predecessors, in regions very remote from what we think of as psychology today. The forerunners of psychology in the vegetable world are seen in the tropisms of plants. We know how plants have a chemic awareness of their needs, are responsive to their surroundings and sense where to obtain those things which they require; they also show themselves competent to reach out and take these things. The most striking and familiar instances are the reaching done by the feelers of plants after light, the shrinking of sensitive plants from the touch, and the setting of their traps for animal food done by the carnivorous plants.

In the animal world psychology has its beginnings in forms so minute that they can be seen only under the microscope. Thus you may witness the seizing of the prey which it desires for food by the single cell amoeba, possibly its temporary escape, the second seizure, the swallowing, absorption and the elimination of the unusable material. In more complex animal forms which are, nevertheless, still microscopic, you may witness the chasing by such a tiny animal of its living prey, the meeting, the battle, the death and the devouring. Here are the precursors of psychic energy of a very feeble character, perhaps too feeble to be called truly psychic; but certainly there is manifested here a form of awareness and selective action, which is the forerunner of the psy-

chology that takes the stage upon the appearance of the higher animals.

And, true to the general law, step by step with the increasing perfection of nerve cell formation and organization in the higher animals there runs parallel an increased variety and power in the forms of psychic energy. In the microscopic animal, and indeed many of the much more complex animals, instinct is the name that we apply to the form of psychic energy that they display. Man is by psychic constitution so far above these animals, his nervous organization so much more exceedingly complex, that his psychic energy assumes the much higher form of consciousness. Our consciousness has almost lost touch completely with instinct, and yet it is very true that those same animal instincts are very largely in control of us and still drive us hither and yon.

The psychic energies of insects, such as the ant and the bee, are exceedingly interesting objects of study. The careful observations of such naturalists as Jean Henry Fabre establish the fact, beyond peradventure, that the performances of the psychic energies of the insect are worthy of our higher admiration. Man can learn much from the ant and the bee and the wasp. Yet tests have been devised which show that these animals have no power of reason. Psychic energy in them is developed to a very high state of perfection so far as each generation repeating the life of its predecessor with minute exactitude is concerned. In fact, there is much evidence to indicate that in many of the insects psychic energy

has been developed and perfected along lines of inflexibility and absolute refusal to experiment that either do not exist in man at all or exist in much less pronounced degree. In them instinct is abundantly able, without any assistance, to attend to the support of the living and the perpetuation of the species. Reason is not necessary, there is nothing left for it to do.

In animals comparatively low in the scale the existence of psychic energy in the form of emotions is clearly observable. The emotions of fear, friendliness, love and anger are on display with increasing clearness as we pass up the line from the lower to the higher animals. The *emotions, then, are distinctly animal psychic energy traits* that increase in scope and complexity as we ascend the animal scale; and their widest range and highest development are reached in the human race and in the more advanced peoples of the human race. For what we may term the most refined forms of the emotions, such as benevolence, mercy, willingness to forgive, and love for an enemy, are exhibited only by the most cultured human beings. These refinements disappear as you descend lower and lower in the scale of culture back to the savage, from whom you must not expect very much more than the brute emotions.

For the first appearances of the instincts and the emotions, therefore, we must go very, very much farther back, not only in history but closer to the root in the pre-history of life itself, than we have to go for the advent of reason or the higher mani-

festations of mentality. Since they are thus at or near the very base of psychic energy, they are fundamental, and exercise far greater control over us than we are wont to realize. We think, without thinking, that the course of our lives is under the direction of our thought and judgment and will. While it is within the power of these higher faculties to direct our lives in a measure, the fact still remains that our instincts and emotions are deeply rooted, not readily controlled, but themselves almost entirely control the entire course of our lives. Up to the present time, for illustration, reason has had practically no part in the directing of human evolution. Perhaps it will have a much larger part in the future, but that possibility can be made reality only through education of the masses of the people to understand how these psychic energies whose roots extend so deep down into the animal kingdom must be subjected to a higher control.

The reader may be wondering what all this has to do with the question of religion. Well, religion has its psychology and we are now discussing the basic forms of psychic energy manifested by human nature. While we are not yet finished with the laying of the ground work for its later full discussion, it may be pointed out here, that the tap root of religion lies buried in the emotions and instincts. Psychic energy rises elsewhere to greater heights and more sublime expression than in the instincts and the emotions. The religious aspirations of man, however, do not originate in the reason and the

higher intellect, but come up out of the depths of that lower strata of psychic energy—the instincts and the emotions.

Self-protection, the preservation of life, is one of the first laws of nature. Not for a single minute has nature ceased to drill this principle into all life throughout the hundreds of millions of years of its existence on the earth. Those animals and those species in which the psychic energies that tended best to preserve and perpetuate life were most highly developed, were the ones that survived. As a result all the living today, as the latest descendants of this long line, inherit in the innermost natures of their being, that basic, instinctive, incredibly stubborn desire to prolong life. When man reached the point where his intellect enabled him to theorize about the question as to whether death were really the end, he worked out a theory of the future life; in other words a religion.

All peoples of all times the world over, who have arrived at a certain stage in the course of mental development have been visited by the notion of another life after bodily death, and have had some form of a religion based upon the longing after immortality. The longing after immortality, the old solicitude in a new form for the preservation of life, our most deeply inherited animal instinct, is the key to the whole religious question, and the foundation of all the religions of all times. But note well here: THEY HAVE WELLED UP OUT OF IN-

STINCT—AND ARE NOT AN OUTFLOW OF REASON.

Recent discoveries show that European races which existed at least 25,000 years ago probably believed in life after death. All the generations of men that have existed since that time and all the savage, semi-civilized and so-called civilized races on the earth today, have based their religions on this instinctive desire to prolong life. And let it be noted here that religion attains to its higher development in those races and in those individuals in which *emotional* psychic energy rises to the greatest heights; and that which we generally mean by the term religion sinks to its lowest ebb in those in whom the emotions are best under control and in whom the faculty of reason is most highly developed —in our scientists, philosophers and scholars.

Now it ought to be clear beyond dispute that all people without exception have these basic and instinctive emotional energies entering into their make-up. None escape the risk of falling under the domination and control of the emotions. But there is a still higher development of psychic energy, that which comes with education, wide reading and the exercise of the faculty of thought, the sublime faculty of reason.

Reason registers the highest advance of the human mind. It is almost entirely absent in savage and semi-civilized races, all of whom are credulous enough to believe the most impossible things and accept readily stories that a slight exercise of the

faculty of reason would cause them instantly to reject. Religious beliefs arise while human races are in the low state of culture that precedes the rule of reason. Thus the most primitive savages, you will find have a full outfit of religious beliefs very tenaciously held, and a more or less elaborate set of forms and ceremonials on a level with their lack of intellectual culture. There will always be as many religious beliefs and varieties of religious ritual and ceremonial as there are intellectual cultures in human races the world over. Many volumes are required to set forth the many and greatly varied religious beliefs and to describe the ceremonials of the various peoples on the earth today.

All peoples have emotions and all peoples have religion. But in comparatively few people is the faculty of reason well developed, and for religion to retain its hold upon these advanced minds they must go through a perfectly parallel and natural higher evolution of religious thought. It is very much to be desired that all of us who strive to extend the boundaries of our education, add to the disciplined strength of our reason, should at the same time find the way to sounder and more rational religious beliefs.

Yet it remains true that animal instincts and emotions are basic in human character and human nature and for a long, long time they are going to exercise a large measure of control in the majority of the race. We have not yet arrived at a point of evolutionary perfection where reason can supplant

them. Individuals in indefinite numbers are still in subjection to their instincts, entire peoples are yet controlled by their emotions, the world is still governed and international treaties written, not after the direction of the higher reason, but at the behest of animal emotions.

But reason alone enables us to determine how sound or how untrue a proposition is. The emotions do not tell us what is true and what is false; in fact, emotional energy is powerless to deal with the question of truth and untruth. The emotions and instincts move on planes distinctly lower than reason. The work of deciding a question, the determination of the correctness or incorrectness of a theory, involves the gathering of evidence, all possible pertinent evidence; it calls for the accurate weighing of that evidence, and a calm, level-headed sane judgment as to what that evidence really indicates to be the truth. How can the emotions like fear, hate, love, or longing for life, deal with such a question? It is perfectly obvious that they cannot. Every emotion has a correct and natural office to perform and man could not have developed to his present state of relative perfection without them. But they are distinctly out of their element when it comes to dealing with questions of philosophy, of Truth. Sane decisions on the profound questions with which the church and theology aim to deal call for the exercise of the highest powers of reason and that takes place on an entirely different plane from the emotional. The emotions, instincts, the religious

beliefs and longings, instead of acting as the judge on the bench become witnesses that have sound testimony of their own to present. But reason occupies a higher throne from which it is in a position to understand and weigh all the evidence and determine the soundness or unsoundness, the truth or untruth, of any belief.

Now it does not require any particular mental ability to accept a belief; in fact belief is the easiest thing in the world to the undeveloped mind. The most ignorant savages can believe at random, for their minds are mainly under the sway of the emotional. Since the reason is conspicuously missing, it is easy for them to believe even in the unreal. The number of queer, fantastic religious ceremonials among savage and semi-civilized races and the infinite variety of the forms of belief in immortality by races of people the world over are ample evidence of this unmeasureable credulity. Obviously they cannot contradict each other and all be correct. In fact it is a practical certainty that they will be full of error, for their minds are governed by the emotional, and the emotions are absolutely incompetent to deal with the question of Truth. And since all religions have come up out of the depths of the emotions, even the religion of the most refined and cultured peoples, it is not to be expected that their religious beliefs will check up and be found reasonable when the reason subjects them to its tests.

Memory and reflection are manifestations of psychic energy on planes that are very much higher

than the emotions and instincts. For instance, these higher psychic actions prepare the way for real thought. The instinctive and the emotional action does not result from the push of real thought but from impulses under the control of chemic or other forces. By the exercise of memory and reflection scattered ideas and psychic impressions are correlated and a sound foundation for reason laid. The mind thus learns to note the difference between its ideas and its sense impressions. It learns to tell the difference between the desirable and the undesirable and the ability to select the most pleasing or satisfying course of action to the organism. Thus we have the dawn of intelligence—a selective choice between alternatives resulting from a modicum of thought based on a minimum of experience.

Once the realm of simple intelligence is reached, psychic energy begins to take on further refinements and perfectings which we designate by the terms higher consciousness and reason. In those in whom consciousness and reason are well developed the emotions also are put to much higher and more refined uses than is the case among the less cultured.

The higher consciousness consists of an awareness of self, the power to compare and correlate the various instinctive impulses and emotions that constrain us. Consciousness is introspective—it looks within and explores the organism itself. In savages there is far less awareness of self, less exploration of the ego, and in the lower animals probably none. Acquaintance with the self comes only with the

coming of a comparatively high or complex nervous organization.

And we must keep this fact ever in mind here. Exactly parallel and hand in hand with the higher evolution of psychic energy there runs the higher evolution and more complex construction of the nerve and brain systems in the organisms concerned. The gray matter in the brain of man is the most wonderful product of all nature. The inconceivable complexity of structure in the cortex of the brain and indeed in the entire nervous system of a well developed human constitutes the highest form of organic development to be found anywhere. From what we have discovered of the relationships between structures and energies all through the preceding pages we should expect that such a wonderfully complex organism would be the instrument of wonderfully complex energy manifestations. This is the simple logic of the case and we do find such energy manifestations, not only in the form of more refined emotions, and flights of religious fervor, but also the copious expenditure of intellectual energy, expressed in the form of rational thought. Man now is somewhat able to understand nature, self, other men. With the aid of this new power he masters natural laws; realizes he has rights as a man; that others also have rights; that an orderly social process must be sought and found and supported which will be to the best good of all.

Out of the activity of these higher phases of psychic energy develop the science of sociology,

which studies to learn all it can of the rights and duties and correct relationships of the life of men in groups; and the science of ethics, which deals with the moral problems not only of individuals but of groups, nations, races and all humanity, and even takes in the problem of right relations between the human race and other animal races.

The process of rational thought, the weighing of evidence in its efforts to get at the truth, the flights of the imagination, all involve the expenditure of nerve energy. It is the discharge of the battery of the brain, and is accompanied by a chemical change in the brain and nerve cells just as truly as a chemical change occurs in the plates of an electric battery as it discharges. Thought changes thus exhibit a certain parallel with chemical changes; and just as the degree of intelligence of which a mind is capable depends upon the fineness of the organization of the brain cells, so the amount of psychic energy that the brain can discharge in the form of thought or the expression of thought corresponds to the amount of nerve energy that is stored in the mind ready to discharge. In fact, the process of thought may be formulated in the terms of electric discharge and the volume of thought may almost be measured in kilowatt hours. Great mental effort means expenditure of a great amount of nervous energy, and the brain worker becomes fatigued even more than the muscle worker. Microscopic examination of the nerve cells before and after such exhaustion shows very remarkable differences. Rest, food, sleep re-

charge the nerve cells ready for another day, but that day's output of thought spends the energy that the food brings again to the brain. Thus does the high science of psychology send its roots down into the physical science of chemistry.

If we will but learn to know ourselves, the chemical nature of our makeup; the dangerous way that chemic disturbances are followed by psychic disturbances; and how our primary instincts and emotions are so prone to stampede us into unethical relations with our fellow men, we shall realize that even if we strain every effort to deal fairly and honorably with our fellow men we shall still fall short because of our inability always to control our animal natures. Nevertheless, if we make the effort, progress in the solution of the problems of sociology —capital and labor, the relationship between man and the eternal Right, between man and God—may be somewhat quickened.

Now we are apt to overlook the fact that a human being is a most intricate labyrinth of different energies. For the human body is largely a chemical retort. Raw chemicals are fed into it as fuel to the furnace, chemical operations go on therein, and energy undergoes transformations from one kind to another, from electric to chemic, and to those forms that we term the life or biotic energy and psychic energy. And psychic energy itself is chameleonlike in its various manifestations; the instinctive impulses, the emotions of various grades, the mode of reason; and that exceedingly subtle

thing so difficult to get at, so hard for our poor minds to comprehend, which we designate as the ethical, the energy responsible for proper relations between individual and individual, group and group, nation and nation. Chemistry enters very largely into all these.

Now the effects of the chemical operations that go on in the human body upon psychical forms, mental habits, temperamental traits, the emotions, reason, ethics, and religion, is so vast a subject that it would require a large volume for a thorough discussion. Obviously we must here restrict ourselves to presentation of a few outstanding points. I feel that this matter is so very important and pertinent to the main subject up for our consideration that a few illustrations must be given to clarify and emphasize the range of these effects.

Suppose the normal chemistry of a man's body be disturbed by putting into his stomach a little of a transparent liquid with the formula C_2H_6O. This is ordinary alcohol which is detrimental to the welfare of the organism. Nevertheless, when chemicals are brought together the reaction appropriate between them is bound to take place whether for good or ill. It cannot be avoided. The nature and amount of the energy that is released in the formation of the new chemical combinations will depend entirely upon the chemical conditions. The after results, also, of that poisonous chemical's presence in the body will vary depending upon the amount that is introduced. Alcohol produces certain effects

upon the organs, and affects the mind in certain ways. But the noticeable thing is that alcohol gets in its effects first upon the mind and its most profound influence is felt in the realm of the higher mentality. A comparatively small amount of alcohol will upset a man's reason and judgment, leaving his emotions and instincts even more firmly in control. Reason and judgment, the finest forms of psychic energy but the latest to be developed, are the first to suffer aberration; as yet the instincts and emotions may not be dulled in the least. Those refinements of mind that make a man a man and elevate him above the beast are the first to collapse; but we need not dwell upon the painful spectacle by which the noblest work of God is reduced lower than the brute through a process of chemistry initiated by the drinking of alcoholic liquors. This explanation of the principle involved must suffice.

At the risk of the repetition growing tiresome, we refer again, because it is of fundamental importance, to the fact that the entire sweep of mental and moral activity in man comes up out of the depths of the physico-chemical structure of the organism. As that structure increases in complexity, psychic energy increases in the number and variety of its forms; step by step, also, with this increase, an increasing lack of stability or equilibrium, of dependability of action puts in its appearance. The instincts and emotions are very stable and dependable because they are very old; but reason is comparatively young, and flighty and easily upset. The

human mind at the top is like the atoms highest up on the list of the pure elements; the more complex the organization in each case, the more radioactive and unstable it becomes. Again, just as the radioactive elements, such as uranium, throw off energy in forms as yet difficult to understand, so the energy thrown off by the brain from the highest stages of its growth is little understood. But there are indications that this energy can be picked up at a distance by a second similar highly developed organism and its intelligence decoded, much as the energy shot out from a radio broadcasting station is picked up at great distances by properly constructed and sufficiently delicate radio receiving apparatus and the intelligence which it bears correctly translated. But this mental form of radioactivity is so subtle, so difficult to get at, that science has thus far been baffled in all its attempts to discover the principles of its actions. Science some day by massing together additional facts in this realm which are only inaccurate guesses today, may discover the relationship between this radioactivity of the brain and the process of reasoning and be able to determine the natural laws that apply to it.

Now it is a long, long way chemically from the combination of chlorine and sodium to the human body and brain so infinitely more complex in chemical structure. In the simpler combination the chemical product or result is also relatively simple and stable and it is easy to see the process at work always producing the same result. But in the highest

of the living animals, the complexity of chemical operations going on in a structure so vast staggers all our attempts at understanding them in detail. And the complexity of energy forms that are thus produced is even more difficult to understand. This applies particularly to that energy sense of perception which enables the organism to *take note of its surroundings* and of itself; and to that still higher form of mental energy, or operation of the mind whereby we cogitate, or think. In these regions the mind is very radioactive, very unstable, very unreliable. It acts like the flickering of the tip of the flame above a roaring furnace; deep down in the furnace there is the simple chemical action, the combination of the oxygen of the air with the carbon in the fuel; but from it rise the flickering, moving, evanescent flame tips, aspiring to something higher —here now, gone the next instant, difficult to control; yet this flickering flame is the point of ultimate chemic reaction, the point of release of the very highest type of mental or spiritual force. Mental and moral and spiritual quality, as we can all readily observe in humanity about us, depends upon the perfection of the organism from which it proceeds. The very highest flights of imagination and reason and examples of moral concept and religious fervor are the combined product of the higher emotions and the *cogitic* or thinking actions of the brain, and these sink their roots deep in the simple chemistry of the organ.

That the mental and moral have come up out of

the depths of the physical is demonstrated in the lives of every man, woman, child and animal the world over. If this is not evidence enough, confirmation has been provided over and over again by an almost endless series of experiments, tests and surgical operations on the brains of both animals and humans. Moral delinquents, whom many would penalize, have been cured by simple surgery. Every brain specialist knows, as he knows his alphabet, men and women in whom defects of character which would cause many to condemn them arise out of physical defects for which the individual is rarely if ever to blame. An underdevelopment of certain organs, or an overdevelopment of others, may throw out of balance the normal distribution of chemical substances within the body. Sometimes a blemish of character is due to an inherited trait, which it is physically impossible for the man to correct himself.

Every physician, particularly every brain specialist, knows that in the average run of humanity a very large percentage are the victims of physical and nervous structural defects, which make it *absolutely impossible* for those individuals to make the grade, mental and moral, necessary for them to qualify as decent members of society. The army mental and medical tests were a shocking revelation of the truth of these statements.

But the present point is, the absolute continuity, without the slightest break in the chain, that exists between the chemistry of the retort in the laboratory, the chemistry in the food canal and in the glands

of the human body, and the energy released in the forms which we call mental. It is common knowledge that strong mental power is impossible where the necessary energy has not been supplied to the brain in the form of food. The undernourished child finds it absolutely impossible to learn as quickly and as readily at school as the well fed child who sits next to him. We are all familiar with the effect of the drinking of coffee as a mental stimulus, and how the eating of a too heavy meal interferes with the best mental activity shortly after.

In "The Physiology of Mind," by Francis X. Dercum, A.M., M.D., Ph.D., you may read in considerable detail of the growth and development of nerve and mind structures and their modes of operation from the simplest cell, the amoeba, up to man. The selective sense in the lowest organisms cannot in any way be termed mind, but is clearly a matter of physico-chemical reaction. As we go higher and higher with organisms in complexity of structure, successive improvements take place in the organs of sense perception. Based on the exceedingly complex structure of the human brain and nerve cells, perception and reaction reach the multiple stage of their development in the consciousness and mentality of man. But these are seen clearly to be, like all biological phenomena, not a separate building, but an upper story added on to the single structure whose lower stories are occupied by the lower sciences of physics and chemistry.

There is another window which lets light in on

the chemic basis of mentality, and therefore helps to explain the religious attitude, which is very pertinent here. Specialists who have been studying certain organs within the human body, known as the endocrine glands, have found that to a very remarkable extent a number of them, particularly the thyroid, the thymus, the pituitary body, the adrenal, and the sex glands, exercise a powerful influence on personality, character, mentality and morals. It is now thoroughly well accepted by close students of the matter that the life of an individual in every stage of his progress from the cradle to the grave is affected very largely by the glands just mentioned, together with a few others which are also included in the endocrine group.

By purely chemical processes, these glands secrete products which are carried by the blood all through the body and the influence exerted by these secretions is by no means slight. Certain glands predominate in some individuals and their character, conduct, mentality, morals, religion can be shown to be affected by them in particular ways. In other individuals in whom other glands are more prominent, other types of character, mentality, morals and conduct are in the ascendant. With this very pertinent kowledge as to the basis of personality in one's possession as a key, it is exceedingly interesting to pick out an individual, and watch how his reactions under differing circumstances and emotional conditions, are in direct correspondence with the operation of the chemistry of his system. His responses

are so prompt and unfailing under differing circumstances that one who understands his physiology might prophesy them with almost as unfailing accuracy as a chemist might prophesy the result of a particular conjunction of chemicals.

These endocrine glands sometimes co-operate together and in some instances inhibit each other; a constant play and interplay goes on between them of action, reaction, stimulation and inhibition. Their activities lead not only to differences in physical characteristics and what may be termed the strictly animal traits, but glandular action extends its influence with unfailing certainty to embrace, and affect for good or ill, mental ability, moral concepts, business and personal conduct, aesthetic taste and all that makes the personality and character of the individual. Usually one gland or a few glands are more powerful than the others and which of these is, can be told from the way that not only the physical but mental and moral traits are affected. It is well established that the entire personality and its actions and reactions throughout life are directly affected in large measure by the chemical products of the endocrine glands.

Furthermore, the endocrine gland traits, and therefore the physical, mental and moral characteristics that arise therefrom, are inherited. The babe is born into the world with its future largely predetermined by the chemistry of its organism.

Volumes have been written upon the physical, mental and moral effects of the secretions of the

endocrine glands, but little more space can be given to the subject here. We will consider a single illustration, however, the operation of the thymus gland. It is located in the chest, astride the lower part of the trachea, or windpipe, and it overlaps the upper portion of the heart to some extent. In children in which the thymus gland is inactive or absent, idiocy results. In the adult in which the thymus gland is too active and the influence of its secretions is not held in check by the products of the pituitary and the thyroid, a degenerate character is the result. Berman[1] says:

> "Moral irresponsibility is the keynote of the volitional traits of the thymo-centric personality from childhood up. In the alcohol and drug habitue wards of hospitals as well as in medico-legal cases of degenerates, gunmen and other criminals, the characteristic conformation and diagnostic stigmata of the thymo-centric are often encountered. Life treats them badly. Thus misunderstood and misjudged, they are the hopeless misfits of society. If the pituitary and the thyroid can enlarge to compensate for their defects, they may become the queer brilliants, the eccentric geniuses of the arts and sciences. Should they not, mental deficiency and delinquency are their portion. Epilepsy, then, is sometimes their mode of escape from the terrors of an utterly foreign world. Should

1 Louis D. Berman, *The Glands Regulating Personality.*

> they survive all other hazards, suicide may still be their most frequent fate."

But if science, through a careful study of the chemistry of such an individual, can find out what is lacking, and by supplying that lack, establish the normal condition of the body, this is followed by results *in the moral sphere* which are as truly wonderful as the alleged miracles of ancient times.

These modern miracles are being performed daily in our hospitals through sane, scientific treatment based on the above form of diagnosis. Insanity has been permanently cured, moral delinquency has been corrected, the beast in human form has been turned into the cultured gentleman. This is the modern, the scientific attitude toward such unfortunates, and the sane process of treatment is to correct the basic chemic faults in the organism which bar the way to the development of an upright moral character.

Reason is the highest known energy form associated with man's bodily organism. It represents the climax of the chemic-biotic-psychic series of energy development. But his reason tells man that he cannot live to himself alone. Relationships with other human beings in general like himself, but each differing somewhat in physical, chemical, biotic and psychic constitution, are necessary to the individual's psychic health. Man must learn to live and get along with others. We must act together in groups; in small groups, such as the family, the business

organization, the community; and in large groups, the city, the state, the nation. These larger groups must learn to get along with other large groups, other cities, states, and nations. The solution of this problem of getting along with our fellow-men, the world over, is one of the most pressing mental tasks that have ever been laid upon the human organism. Naturally because it is comparatively new as well as exceedingly complicated, its urgency is little understood. The notorious lack in the world of sane co-operation, inter-individual, inter-racial and inter-national, is productive of endless friction. The awful limits to which misunderstandings among men can lead was demonstrated in the great war which shocked the entire human race. But that catastrophe only makes it plainer that we must learn to get along with other men. Out of the necessity thus laid upon men has arisen the very highest of the sciences, the science of ethics.

The science of psychology therefore reveals the fact that its realm is under the control of laws; that these laws are directly related to the laws of biology and chemistry, and carry them one step higher; that the truths of psychology are not isolated from but dovetail into the one great Truth of all nature. In all the various ramifications of the science of psychic energy, we have found, therefore, evidence in abundance of the presence of law, order, harmony with the rest of the cosmos, and energy at work.

CHAPTER X

THE VOICE OF ETHICS

Law, Order, Cosmos, God

Ethics may be defined as that science which tries to get at the right and wrong of men and measures, in matters individual, neighborhood, racial, national, and cosmopolitan. It concerns itself with fair play between man and man, between man and the balance of nature, between man and the Supreme Cause which we call God.

It is clear therefore, that since the science of ethics occupies itself exclusively with the problem of human relationships, the chief task of morals is to work out the most perfect conception of human relationships of which our minds can think. For the present, then, our interest will be centered on the problem of moral uprightness and the perfection of human conduct which is its goal.

Now the very nature of religion, whether what we have in mind be the religion of the modern civilized gentleman or the religion of the savage, is to idealize and revere a being of as perfect moral or ethical nature as it is possible for its devotee to visualize. The numerous religions that have troubled the minds of men through ages past, have

set their seal on a great variety of ideas pertaining to the Supreme One, and on as great a variety of ideas as to what constitute ideal moral character. For instance, the barbarian, intensely superstitious and religious in his way, is very backward in his morals according to our standards. He does not hesitate to hunt the heads of other tribesmen and thinks that the murder of a sleeping enemy is an accomplishment of which to be proud. Yet moral ideals of his own, he does possess, and religious fears; and he endeavors to live up to them faithfully.

It is obvious, therefore, that if we are to focus the problem of ethics in the proper light we must view this subject impartially and seek out the natural laws that pertain to the science of ethics itself aside from either Christian, Mohammedan, Buddhist, Atheist or any religious bias. We must study the science of ethics in its purity. And if the human race, or its constituent nations, are to make any substantial advance in ethical thinking and the development of beautiful character, the pure science of ethics must be taught in our public schools as well as in our institutions of higher learning; not only to a favored few, but to all as nearly as possible. For, at the present time there are very, very few who have the opportunity offered them for unbiased or scientific study of the natural principles of ethics.

Throughout the preceding chapters orthogenic law was seen in operation by which nature makes

her combinations: elements and atoms and molecules and organs and groups of organs, ever more complex in their arrangement. Exactly parallel with this increase of complexity in *material* structure, a corresponding increase of complexity occurred in the *spiritual,* as shown by numberless new varieties of energy manifestations. Throughout all the history of biology and biological development, under the control of the principles of heredity and the survival of the fittest, qualities of the better grade continue to be preserved. The good remains, the bad perishes. The good perpetuates itself, while the bad is powerless to stem the tide of oblivion. The biologist sees this success of the good and failure of the bad in countless instances connected with the physical development of species. The observations of the psychologist show the same law at work in the psychic natures of animals and men. Because the good in the mental or instinctive make-up of the animal tends thus to perpetuate itself, the law of ethics, or the law of right and wrong, it is plain, applies to the lower animals as well as to the human species. Thus the moralist may begin his study of ethics in such insects as the bee, the ant or the wasp, and find moral principles reaching quite a remarkably advanced stage in such animals as dogs. Morals is not a science confined entirely to man, though it does reach its highest perfection in the best men. For ethics arises out of psychology, and the beginnings of ethics may be observed in any species of the animals characterized by a comparatively high state of social development.

The point I wish to make here is the *cosmic nature* of the principles of ethics. It is a full brother science to physics. It is no more a creation of man, and as much a part of nature, as chemistry. If there were no such thing as the religious instinct in man the outstanding importance of the science of ethics would be even more clearly recognized. The principles of moral conduct are written into the very nature of man and of mind, and deserve consideration on their own merits, entirely separate from the interest of our theology in them. Moral laws are cosmic laws, just as truly as are the laws of gravitation, of chemical affinity, of magnetism, of electricity, of biological growth, and of psychological growth. Furthermore, the cosmic laws of ethics do not conflict, but are in exact harmony with the cosmic laws of psychology and of biology. All cosmic laws co-operate perfectly with each other.

The higher we ascend in the scale, animal and human, higher and higher is the appreciation of the province of moral laws that meets us. That appreciation runs parallel with an individual's education, parallel with the degree of his understanding of nature and nature's laws.

Moral Law Is Cosmic Law

We will proceed, then, on the footing that all moral law is cosmic law. And it will help us on our way to give some thought to this cosmic nature of the principles of ethics, and the fact that moral law has all the stability and immutability attached to it

of other laws of nature.

Humanity is terribly in need, in truth, of a new and sounder appreciation of how the cosmical character of moral law makes it certain that the violator of moral law is going to pay the penalty just as surely as if he violates a law of physics, a law of chemistry, or a law of biology. We must re-educate men to this truth that violation of moral law brings its inevitable punishment, and that there is no system whereby this law of retribution may be nullified. We must spread the news that moral law is on a par with chemical law; that violation of it inevitably brings punishment; and, moreover, that this punishment is deserved and for the welfare of humanity.

This principle, the cosmic nature of moral law, must in the future receive the homage from men that is its due. We have been in the habit of thinking that moral laws were man-made ideas designed by us for the better ordering of human affairs. But if we consult the history of races and religions we will find that the basic moral laws have not been inventions, but discoveries, the same as the basic laws of electricity. Different peoples in different ages as their civilizations developed discovered those moral laws, one by one, and the words in which they have expressed them mean approximately the same thing. The point to be remembered here is that moral laws were *discovered,* as truly so as the laws of chemistry. They belong to nature external of and internal to man, and man has merely established conscious contact with them. For instance, the

moral principle of the Golden Rule has been discovered in turn by all civilized peoples, and it has been written into the teachings of all the seven great religions. Quoting from Mr. Alfred W. Martin's book, "The World's Great Religions," this moral principle is variously expressed in the different religions as follows:

> *Hinduism:* The true rule is to guard and do by the things of others as you do by your own.
>
> *Judaism:* (1300 B. C.) Whatsoever you do not wish your neighbor to do to you, do not unto him.
>
> *Zoroastrianism:* (1000 B. C.) Do as you would be done by.
>
> *Buddhism:* (600 B. C.) One should seek for others the happiness one desires for oneself.
>
> *Confucianism:* (550 B. C.) What you do not wish done to yourself do not unto others.
>
> *Christianity:* (30 A. D.) All things whatsoever ye would that men should do unto you, do you even so to them.
>
> *Mohammedanism:* (622 A. D.) Let none of you treat your brother in a way he himself would dislike to be treated.

To the student of ethics this is merely a cosmic moral law designed to promote the welfare of humanity in general. I am very glad that such a brilliant and renowned scientist as Professor Robert A. Millikan has emphasized this point. At a

meeting of world-famous scientists, when Madame Curie was presented with one hundred thousand dollars' worth of radium, Professor Millikan said:

> "From my point of view there are two things of immense importance in this world, two beliefs upon which, in the last analysis, the weal or woe of the race depends—*the most important thing in the world is the belief in the reality of moral and spiritual values.* It was because we lost that belief that the world war came, and if we do not now find the way to regain and to strengthen that belief, then science is of no value."

In bolstering the faith of men in the supreme importance of moral principles and spiritual values, it will help enormously if a way can be found to get them to change their ways of thinking sufficiently to comprehend that morality is on the same footing with electricity; that violation of moral law, therefore, will bring disaster just as certainly as touching a live wire with the bare hand; and that obedience to moral laws shows as large a return in spiritual profit as obedience to the laws of electricity does industrially. The religion to which the future belongs is one in which that vision is believed and followed.

It is by the operation of cosmic laws of psychic energy that there has arisen in the minds of peoples of all times a spirit of reverence, a desire to worship. Because man has never previously understood

the nature of these cosmic laws of psychic energy he has naturally made mistakes in the formulation of his ideas of Deity. The rapid advance, however, of scientific progress in the last half century has at length made it clear from many different angles that it is to these cosmic laws of psychic energy we must look for a better understanding of the object of our reverence. Studying the religions of the past from this point of view, we can now answer the questions how and why righteousness was the outstanding feature of the Judaic religion; how and why various religions took on the forms and ceremonies that characterized them. While they were acting blindfolded under the impetus of certain of these cosmic laws of psychic energy, they had not been able to win their way to the light by which to arrive at a better understanding and a fuller appreciation of those moral principles whose partial sway they owned.

Those elements survive, and will continue to survive, out of Buddhism, Hinduism, Confucianism, Judaism and Christianity which are in harmony with these cosmic laws of psychic energy. The rites and ceremonies and beliefs that are discordant with these cosmic laws of psychic energy are doomed to drop by the wayside as fast as men find that they are not essential to their welfare. "The truth is mighty and will prevail," but error has no substance and cannot last forever.

Now that evidence has been presented to show that the laws of morality are on an equal cosmic

footing with the laws of electricity, it may be well to call attention to the new dignity thus conferred upon a few of the more familiar ethical obligations which, it is generally agreed, should apply in the relations between human beings. The fatherhood of God and the brotherhood of man form the basic principles of our religion. The same principles are commended to the faithful also in the other great religions; for homage has long been paid to them not only by leaders of Judaism and Christianity, but by leaders of Mohammedanism, Hinduism and Buddhism. In other words, religious leaders of all times have been telling men that these two principles have a legitimate and binding claim upon their allegiance. But men have said to one another that these were counsels of perfection that ordinary people could not be expected to put in practice.

The new understanding that the ethical laws which govern the relationships between human beings are on all fours with the law of gravitation, the laws of physics, of chemistry and of biology puts another face on this whole matter. As soon as the religion to which the future belongs convinces the masses that violation of a law of right never works out well, while obedience to it can never work out ill, religion will be taken with a seriousness for which the world offers no precedent, and its new influence upon its members will greatly accelerate the development of beautiful characters.

By the cosmic laws of psychic energy, it is ordained that all normal human beings shall be inter-

ested in each other's welfare. Our interests are interlocked. I like to call this rule of conduct the law of mutuality, for it is decreed of the system to which we belong that the welfare of the individual lies in the welfare of the race. A study of the lives and habits of all animal species bears this out. What is best for all is best in the long run for the individual. The law of mutual service is a cosmic law of psychic energy, a God-given law, if you prefer that language, and no man, therefore, can disobey it with impunity. This new realization that no man ever gets round a moral law who does not swindle himself badly in the process will lead men to an immediate decision that their business relations must be subjected to a thorough housecleaning, and the rules of the business game will suffer radical revision.

But the problem is one of education. The religion with a future will have to find ways and means by which to effect a very revolution in the present world's thought of morality. *By the teaching of ethical principle in the terms of science and natural law,* hosts of men must be induced to reverse themselves and join in the formation of an overwhelmingly strong public opinion in favor of obeying the laws of morality as other natural laws are obeyed.

There is a tremendously urgent need for this new kind of moral instruction of the young. An alarmingly large percentage of the crime dealt with in our courts is committed by boys and some girls under twenty-one years of age. About the only means of moral education we have at present outside the home

is in the church and Sunday school, and it is quite obvious that these means are not meeting the needs. We must have moral training in our public schools upon the basis of natural law, courses of moral hygiene on exactly the same footing as courses of hygiene for the body.

Theodore Roosevelt fixed public attention on the fact that people educated in intellect and not educated in morals will become a menace to any nation. The truth of this is obvious. But it should be just as obvious to thoughtful people that there is at present no adequate means of putting moral law and the understanding of moral law into its rightful place in the minds of our young people or even our adults. And, benefiting by what we know of the laws of psychology, we can be sure that moral and religious instruction can best be given while the individual is in the early years, when character and mind are first forming.

The churches already have at their command a vast and powerful organization, with plants and equipment located at advantageous points to reach the great majority of all our people with these new courses of moral hygiene. But many who need this instruction do not attend, and those who do attend still do not understand the absolute compelling power of moral law. They think it is something men can beat if they are shrewd enough. The religion with a future must make up its own mind that the laws of morality are cosmic laws and that back of moral law enforcement, at all times and in all

places, are the full resources of the Infinite Power. That reading of our human relationships must be put into the human mind in such a way that it will absolutely carry conviction and win co-operation. If the established orthodox church proves wise enough to reverse itself and embrace the doctrine that the laws of morality are cosmic laws of psychic energy, if it will provide itself with teachers equipped to instruct our youth in these new courses of moral hygiene, that will pave the way to a decidedly more believable, scientific, convincing, livable, effective religion. Is that too much to hope?

The public school is established to prepare children to make a place for themselves in the life of the world. But the public school has given practically no attention to the subject of courses in moral hygiene. Somehow the boy or girl inclines to believe what is taught in the public school. On the other hand, consciously or unconsciously, they sooner or later come to look upon the teaching of the church as mythical or open to question or alternative interpretation. The religious school must seek and find effective means to alter its status in these respects in the minds of the young, so that the religious student in the Sunday school will act upon his instruction there with the same confidence that he acts upon his instructions in the public day school. With our religious school so revolutionized, and with our public schools giving proper attention to this very, very important subject of ethics, in the lower grades as

well as the higher, the rising generation will secure a sane, constructive understanding of moral laws that must make great differences for the better in their conduct throughout the balance of life.

The point cannot be too highly emphasized that were we to give our children these new courses in moral hygiene, we would be teaching them truth of the most profound and highest order, most religious, indeed, for like every other law of God, the laws of morality are bits of religious truth. Nothing elsewhere can be higher, nothing more religious in the highest and most holy sense; for in the study of moral law enforcement we are dealing directly with the Infinite.

Ethics, then, is a science able to stand upon its own feet, and should not be made an adjunct of any religious creed. It should no longer be thought of in exclusive connection with religion, or any more closely tied to it than to psychology or biology or chemistry or astronomy. It is true that all the sciences should bear a just relationship to our religious thinking; or, to state it more clearly, our religious thinking should bear a just relationship to all the sciences, including the science of ethics. But we must learn to look and act upon this subject of moral development exactly as we look and act upon the subject of mental development or physical development. They are natural sciences and should be studied by the scientific method in the public schools; not left in the hands of Sunday schools which are far from scientific in their method.

And just here it will be well to remind ourselves that the ethical sense, the realization of right and wrong, is an *acquired* faculty. We are not born with it. The child knows nothing of right and wrong and the boy, even after several years of observation and training, may inflict thoughtless cruelties upon his pets and sometimes upon other children. The savage and the barbarian are heartlessly cruel, because they have acquired little judgment as to right or wrong according to our ideals.

The ethical progress of the individual only arrives at its full-grown proportions after considerable mental development and scarcely comes into play at all before the time when the individual begins to extend his relationships with other human beings. It grows by thought and contemplation, and experiment.

Again let it be noted that the ethical sense is a very insecure, delicate thing easily impaired or lost. Since it is the latest development and highest acquirement of the human mind, the highest application of reason, our human hold on it is the most precarious, the most easily broken, the most quickly destroyed. Let something happen which arouses the temper and immediately there is great risk that our moral sense will be entirely submerged and we shall be guilty of conduct which in our saner moments we know is entirely wrong. Let any of his passions temporarily get control of an individual and reason and the moral sense are left stranded.

The connections of the moral sense are very close,

also, with the chemistry of the organs of our bodies. It is only too well known how alcoholism destroys the moral judgment of the individual and converts the most cultured gentleman into a brute. Force liquor down his throat and a man's religious beliefs are powerless to prevent his judgment from losing its fine edges. Once any religious man were alcoholized, his moral principles would be deposed with absolute certainty. The chemic is deeper set in us than the psychic, and it will take command when a contest between them occurs. But let us be thankful that the religious man as a rule does not dare to subject himself to the debasing influence of an intoxicant.

Alcoholism is cited only to illustrate a general principle, for there are many other chemical substances which directly and vitally affect the morale of the user. Different ones exercise different adverse effects upon his morals. They all testify to the fact that the subject of moral law is not freed from submission to biologic law; nor does the subject of biologic law escape from the jurisdiction of chemic law.

Realizing this, that the laws of morality constitute so many chapters of the cosmic laws of psychic energy, it is probable that the most advanced ethical development will occur in conjunction with the higher stages of mental development. That this is true is shown at once by comparing the moral concepts of various races and tribes of people.

Furthermore, our customs and conventions, as they relate to moral principles, are but more or less

crude and tentative attempts to comply with cosmic ethical laws of group life. Our statutes and ordinances and our treaties between nations are but stumbling attempts to state in words and standardize the right course of action in certain constantly recurring situations between men and groups of men; in other words, our statutes and ordinances and treaties are a form of homage that we pay to the cosmic ethical laws of life in groups, that we do not understand yet any too well. Legislation can no more add a single chapter to the laws of chemistry or of biology than it can to the laws of morality. The whole body of these laws already exists in nature. Legislative enactments are merely formal endeavors to set down the rudiments thus far discovered by us of these cosmic moral laws in ways that will add to their recognized authority so that they may be the more readily enforced.

The idea that ethical laws or moral principles, therefore, arise out of man-made laws and customs does them a great disservice. It would help enormously to prepare the way for the religion of the future if the minds of men could be rid of that notion for good and all. Through study to determine our own rights and the rights of others, and through efforts to advance the common welfare, human laws and statutes are made and courts set up to enforce them. If the men making and enforcing them do not properly understand the ethical principles involved, or even if some do but the majority do not, legislation that has no business there will be placed upon

the statute books to be enforced. If the majority do seek to back up a cosmic ethical law by a sound piece of legislation, such as that pertaining to the use of alcohol for beverage purposes, the minority who do not acknowledge the rightness of it, or who have changed the very chemic nature of their bodies through use of alcohol, are going to complain against the enforcement of the law. But all this partisanship for and against human law enforcement does not at all change the fact that cosmic moral law enforcement has behind it the full resources of the Infinite, making it certain that violation of that moral law brings evil results every time, and that only by compliance with these cosmic laws of morality can the best good of all be attained.

All our attempts by human law enforcement to assist in cosmic moral law enforcement might be entirely withdrawn, and we might return to the status preceding any legislation on the subject of alcoholism. But cosmic moral law enforcement as pertaining to the drinking of alcoholic liquor would still be doing business as usual, just as truly as is gravitation law enforcement, because the chemic law involved would not have been repealed. Chemic law enforcement will see to it that the man who drinks alcoholic beverages is punished every time, just as truly as if he were violating any other natural law. But the writing by our legislators of the condemnation first expressed in the cosmic moral law pertaining to the drinking of alcoholic liquor in human statutes is a public proof of our disposition

to co-operate with cosmic moral law enforcement on this subject. There is great need for general public education on cosmic moral law enforcement as it applies to the prohibition question.

Just as our customs and conventions, and statutes are but more or less distant echoes of these cosmic ethical laws, so our efforts at their enforcement are only efforts to be of assistance in cosmic moral law enforcement. Those who do insist upon violating nature's laws, electric, chemic, biotic or psychic, openly confess their lack of understanding that it is absolutely impossible to violate any natural law whatsoever without paying the penalty. In other words, it means, in plain English, that such conduct is an exhibition of the densest ignorance upon a matter of most vital importance both to the individual and to the race.

Now, the church has been combating the alcohol evil for years, and with fairly good results. But when the alcohol drinker interprets the efforts of the churchman along this line as the interference of a meddlesome "reformer," gratuitously seeking to take away his "personal liberty," he is ready to fight back. If, instead of seeing a reformer coming at him on an errand of his own he could be made to understand that it is a *natural* law that he is fighting, the violation of which brings punishment of which there is absolutely no escape, his fighting back would be less strenuous and law obedience would be easier for him.

I have called attention to the fact that our moral

principles are, comparatively speaking, recent acquirements and insecurely established in our make-up. They can be quickly nullified, overthrown. A little avarice, a little covetousness, a little ambition, a little anger, and our moral standards are cast aside. The youngest of our intellectual and spiritual acquirements, they are the first to go. But in this connection another very important factor is worthy of mention by virtue of which we can take courage. In harmony with the biologic laws of heredity, heavy premiums are put upon special valuable characters that are developed in order that they may become permanently fixed. Macfarlane[1] has shown that, "Moral *tendencies* become steadily fixed in the organizations of the organism, if these are renewed and long continued in their renewal."

Now, just what does that mean? It means in the realm of moral relationships between men exactly what the same law means in the realm of botany as demonstrated over and over again by Luther Burbank. Burbank chooses a desirable characteristic in a flower, a cactus, a tree—practically any plant—and then by repeated selection of the best specimens of that characteristic, in the generations of its offspring, that feature is not only strengthened and still further developed, but *it becomes permanently fixed* so that the plant breeds true thereafter as a new species having characteristics different from the old. Just so, in the moral realm, if men hold faithfully to some new high-grade moral tendency generation

1 John Muirhead Macfarlane, *The Causes and Course of Organic Evolution.*

after generation, that tendency will in time become so permanently fixed that it will breed true to form. We know how hard it is to educate lying and stealing out of some tribes of the American Indians and some black races. The desirable characteristics of truth and honesty have not become fixed in the germplasm. Desirable qualities that it lacks must be chosen and this fixing process applied to an entire nation for a number of generations if this world is to become the scene of a more rapid and steady development of a race of morally superior men.

We must then frankly admit that man is subject to many varieties of cosmic law: the law of gravity, the laws of chemistry, the laws of biology, the laws of psychology and the laws of ethics. By thought and study, our knowledge of these laws grows. Thus we can learn to co-operate with them more extensively and by that co-operation promote our own welfare. But if, through ignorance of those laws, we fail to co-operate with them, we must pay the penalty. Or, if, knowing the laws, we still carelessly violate them, our punishment is none the less certain. And always the natural penalties inflicted by cosmic law enforcements are in exact proportion to the magnitude of the offense. Nature's law of compensation is in force here as elsewhere.

The important fact for us to grasp and the happy thought to dwell on here is that by better understanding of these many varieties of cosmic law, and more through co-operation with them, we may promote our own welfare. They will furnish us a chart of the

natural way of moral progress which, it will be seen at once, is in perfect harmony with nature's orthogenic law of higher development. Call it evolution if you wish. But no matter by what name you call a fact, the fact remains.

It would seem, therefore, that the logical procedure for the church, which is an organization essentially for the promotion of higher standards of moral character, would be to apply itself wholeheartedly to the investigation of the cosmic laws of morality and to the devising of new ways and means of human co-operation with them. For this is the most efficient course of procedure for the promotion and progress of society in general as well as the individual. In fact, co-operation is the only means, either by happen so or by set purpose. Even the church is more or less co-operating with these cosmic laws of morality, but if it can lend the hand it does blindfolded, what may not be expected of it with its eyes unbandaged? The unfortunate part, however, is that along with its moral teachings the church is carrying a burden of unimportant belief which prevents clear thinking and correct understanding of added means whereby the welfare of society and individuals may be best promoted.

The main source of this weakness is its refusal to put this article at the head of its list of doctrines: The spiritual, the moral, the good, the true, as forms of psychic energy, are subjects of cosmic law and cosmic law enforcement as truly as biotic energy, or energy chemical or electrical by nature. The elec-

tricity that flows from the generator is just as real as the generator; the energy of chemical affinity is just as real as the elements that are combined; the growth of the plant is just as real as the soil, the water, and the air that enter into its composition; the mind of man is just as real as his bones or his muscles or his brain; the energy of thought is as real as the organ that produces it; the moral principles are as real as those beings which are subject to them. The spiritual is exactly as real as the material and is governed by its natural laws, just as truly as the physical is governed by the laws of material things.

We must learn to look upon spiritual affairs as being a logical and related part of the rest of nature. The laws that govern the energy of chemical affinity are related to the physical nature of the atoms; the laws of electric energy take into consideration the physical nature of the conductors; the laws of biologic growth depend upon the nature of the elements and compounds from which the growth springs; the laws of psychic energy are linked with the physical construction of the brain; everywhere the next higher grade is seen arising out of the next lower, never separate, always related—always subject to this natural law or method of development.

Higher spiritual laws harmonize with the lower, for the science of ethics is only one more link in the chain that includes the sciences of psychology and biology and chemistry. The laws of spiritual affairs are not something apart, something different from

all the rest of nature, nor does cosmic law enforcement see to their enforcement any differently, in the sense of less efficiently, than its enforcement of the laws of chemistry or electricity.

Now it has become clear that the field of ethics or moral conduct is controlled by natural laws, the admission must be made that we but very poorly understand these laws. This is true even of the science of biology, for it, also, is little understood by the majority of us. Psychology is still less understood; and the science of ethics, more recent once again in its development, more intangible, more evasive, harder to get at for study, is perhaps the least understood of all. But it seems very clear that the science of ethical affairs and the cosmic laws of morality which deal with the proper relationships between man and man, between groups of men and between nations and nations, between man and all nature, is the one science where ever more extensive understanding and sane co-operation on man's part is most sorely needed. The precarious status of world affairs today and the strained relations between capital and labor and employer and employe are sample instances of the voice of cosmic moral law enforcement calling our human attention to glaring failures on our part to co-operate with basic cosmic laws of morality.

Once men realize the absolute friendliness and benevolence of the cosmic laws of morality toward them they will realize that the only sane procedure is to redouble their efforts to comply with them just

as accurately as possible. By such deliberate and deliberated co-operation our spiritual welfare will advance by leaps and bounds. There is no way out except to comply with natural spiritual laws, God's laws; we will not advance by praying to God in an endeavor to get the divinity to do *our* will. Our will may be wrong; it probably will be. Our part is to comply with the divine law of ethical growth, not grudgingly, but zealously; and we shall never be willing to do this until men generally keep in mind that the cosmic laws of morality are just as absolute and just as inescapable as are the law of mathematics or the law of gravitation, also, unutterably friendly to our humanity.

Compliance with moral law works out in the final result to be the straight road to the best good to the greatest number. Compliance accomplishes this social well-being without infringement or neglect of its other half of its task which is for the best good of the individual. The purpose of the cosmic laws of morality is to be of assistance in bringing about a higher and higher development of the individual and the community with which he is identified. But, of course, our appreciation of and adjustment to these cosmic laws of morality is very faulty, just as human nature is very faulty in its chemic, biologic and psychic make-up, because human nature has not, by adjustment to them, let the cosmic laws of energy, chemic, biologic and psychic, do a tithe of what it is in their power to do for them. As a result, it is difficult for us to keep in step with those laws of con-

duct so that our action will always be to the best interest of all concerned. As striking examples of this mal-adjustment, we always have with us extreme cases of the grossly immoral, those who violate our most unanimously adopted ethical laws. There is the murderer, the thief, and others that need not be mentioned specifically. How does cosmic moral law enforcement treat these law-breaking individuals?

The welfare of the species is the first ethical consideration, and the individual who places himself outside the protection of the moral law by violating it must pay the penalty, even with his life if necessary. There is an old saying that self-preservation is the first law of nature. This is about one-half true. The really first law of nature is preservation of the species. The individual must be ruthlessly sacrificed for the benefit of the masses when necessary. This is observed to be a natural rule throughout practically all the domain of biology. The bee that stings the intruder near the hive, for the purpose of protecting the colony, itself instantly dies. The drone mates with the queen in order that her eggs may be fertilized and the species continued and itself dies the very instant nature's purpose is accomplished. The individual suffers, but the species is protected. Wild animals in Africa living in territory where lions, leopards and other carnivorous animals are plentiful, travel in large herds as a matter of protection of the species. Individuals here and there may be captured and killed, but their very numbers is

the greatest assurance that some will escape to perpetuate the species. The natural procedure is to protect the species through the sacrifice of the individual.

As soon as the flower has lived through the blossoming period, produced and ripened the seed, it dies because nature does not take the same interest in it now that its purpose of perpetuating its kind is accomplished. The individual is allowed to perish and nature's interest is transferred to the seed which it has matured and its growth to insure the continuation of species is assured. Here, even in the vegetable world, is the perfect analogy to the equivalent moral law that the species must be protected even at the expense of the individual.

The central interest of the cosmic biologic laws is in the species, not in the individual; just so the central interest of the cosmic laws of morality is in the race, not in the welfare of any one of the individuals of the race.

And what do we see as the result? Because the species is protected, it lives on and advances. If the welfare of the individual were of equal or of superior weight, it is very clear that conditions might arise where the very life of the entire species would be jeopardized. But the welfare of the masses comes first, and as a logical working out of this natural law the species tends to advance in moral conduct. Effective safeguards against the extinction of a species means the prolongation of its experiments

to acquire and live up to higher ideals and to higher standards.

The moral law of the perpetuation of the species is therefore a utilitarian law, an economic law, the law of the best good to the greatest number; a law in favor of continued improvement; a law in favor of the higher evolution of right conduct.

Viewing the matter in this light, we now understand why humanity comes first. Giving precedence to humanity, the welfare of the majority is essential to the continuation of the great world experiment in human growth.

Some remarkable motion pictures have recently come out of Africa depicting the wild life of that country in its native haunts. I do not see how any one can look at them, particularly those of animals that are a natural prey of the lion and the leopard, without noting how they are every instant on the alert for danger. Nature has variously equipped them to meet the dangers to which they are exposed; eyes with the keenest vision; ears shaped and hair-lined and movable to pick up the slightest sound of an approaching enemy; a sense of smell of a sensitiveness we cannot imagine; markings that conceal them among the grasses and shrubs and trees; quickness of action and speed in running—all of them efficient means of continuing life. It all shows clearly how, under the strains and stresses of experience, nature has outfitted these animal species with the qualities which enable them to continue to exist.

All this has not been done in a day; it has been the slow work of many generations.

So also in the moral realm, moral laws operate to the higher perfection of the species. It is clear to all of us now that in a debauch of immorality, such as the great war, moral advancement stops. More than that, the human race receives a setback morally. But we are learning from it how urgent is the need, if the race is not to become extinct, for a return to a more general adherence to moral conduct. In the words of Mr. Robert Williams Gibson:[2] "Moral conduct is a system evolved under the stress of experience for the benefit of the individual and the race." And again: "The evolution of conduct is as naturally and positively upward, from lower to higher forms, as is the evolution of physical structure."

What is it, then, that makes conduct moral? Conduct is good or bad in proportion as it benefits the race and the individual, and for that very reason. Where the race is not concerned, self-interest rules; but where individual interest conflicts with social welfare, right of way must be given to the good of the greatest number. This is nature's law. The future of the race is paramount.

The moral law of Moses is in its essential character sound, because when put to the test of compliance, it has always benefited the species and the individual. Humanity could not otherwise have survived. The amount and quality of its compliance

2 Robert Williams Gibson, *The Morality of Nature.*

with it has made humanity what it is. The same thing is true of all the other moral laws for which the church stands, and the moral laws of all religions that have benefited mankind. Exactly in the ways and to the extent of their obedience, the cosmic laws of morality have made the human nature which we possess, today, what it is.

It is, therefore, seen that the primary duty of the individual is self-sacrificingly to promote the welfare of all. The individual must contribute to the common store and thus promote progress or higher evolution. This is his only way to co-operation and harmony with the cosmic law. As Jesus said, "It is more blessed to give than to receive." These words of the Master are scientifically true and in perfect harmony with the cosmic laws of morality. They set forth a law that is fundamental. The religion of the future must show how these laws propounded by the Great Teacher have back of them cosmic moral law enforcement with its irresistible might. Then, we have reason to expect, they will be believed and accepted and lived up to in much greater measure than when men fancy they have no such force or authority behind them.

This whole subject merits the closest consideration of all men because it can put them in touch with the one means whereby their best hopes may be attained. The cosmic laws of morality are the natural means, the lawful means, the progressive means, the only means. The church is vitally concerned to help mankind. Here is the one way by

which it can successfully carry out that intention on a colossal scale. The church is now accomplishing much along this line by short-sighted methods, comparatively, but, as I see it, its weak point is the loss of leverage entailed by its failure to educate men to put co-operation with the cosmic laws of psychic energy on a par with co-operation with the cosmic laws of electric, chemic or biotic energy. The church has no modern interpretation of truth. Present moral truth with all the profoundness and stability of the truth of mathematics and it will be accepted and acted upon. Who questions the principles of mathematics? Who does not believe in the advantages of adjustment to its findings? Who doubts the laws of physics or the laws of chemistry? These things we accept and act upon pretty generally. But they are no more believable, and co-operation with them can be no more advantageous surely than co-operation with the cosmic laws of morality. When we reorganize our theology in perfect harmony with nature and present moral truth linked up with mathematical and astronomical, and physical, and chemical and biological truth, it will be accepted and acted up to as they are.

If we are truly moral, or want to be truly moral, we will endeavor to know as much as possible of all of nature's laws because of our firm persuasion that co-operation with them is our best course. Only in this way, we know, can we avoid losing conflicts with the creative will, and only in this way can we accomplish the best good for ourselves and man-

kind. By such co-operation with ethical laws must we advance, or else we shall either stand still or slip back. This is the only way to success, for we know that nature's laws cannot be cheated. There is no way around, no exception. We may sit in judgment on man-made laws, but we know that these ultra-human laws always sit in judgment on us.

In view of the fact that in the highest and most perfect possible compliance with moral law lies our greatest good, we must also remember that the *heights reached and held by our moral concepts are dependent upon the intellectual attainments* of our people. The two run parallel. We cannot hope for mass advance in moral growth and development without mass advance first in knowledge. Moral growth of the group will not outrun but must keep step with mental growth—that is the natural law. The most moral races are the most intellectual races and the most immoral are the most savage and ignorant. We must help on growth of moral understanding in every way possible, in the homes, in the schools, in the churches, through our periodicals. But moral understanding is never likely to run ahead of intellectual strength. In my judgment real comprehension of the force of moral law in all its majesty and beauty and power is impossible to the person who does not have a basic knowledge of the natural sciences.

The moral nature of man is the very highest pinnacle of the entire process of creation through evolution. From that altitude we may look down upon

and see all else that is spread out to view. It is the Creator's most marvelous, most wonderful work. It is the most perfect specimens of moral nature that approach most closely to our conceptions of Divinity and that give us a new and intensified appreciation of the majesty of the position which man occupies in the world. As Immanuel Kant expressed it, there are two things that fill the mind with increasing admiration of awe: the starry heavens above and the moral law in the heart of man.

Thus Shakespeare: "What a piece of work is man! How noble in reason! How infinite in faculty! In form and motion how express and admirable! In action how like an angel! In apprehension how like a god! The beauty of the world! The paragon of animals!"

Accordingly, in ending our consideration of ethics, we can say that we have encountered no deviation from the general orthogenic principle which is operative in all the other departments of science. Everywhere we find, Law, Order, Cosmos, God.

CHAPTER XI

THE PHILOSOPHER SPEAKS

Law, Order, Cosmos, God

Hitherto we have been discussing the findings of the scientists in their separate specialized fields of research. It is now necessary to take a philosophical view of the entire scope of human knowledge.

It is the function of the scientist to search for truth wherever it may be found. He has no unchangeable opinions. He is working toward no predetermined final goal. He is not looking for evidence in proof of any foregone conclusion. He is altogether absorbed in search of truth, and when he stumbles upon a truth he had not expected to find he accepts it without question. He follows wherever it leads. The new-found truth may overthrow former opinions of his, but he welcomes this, for he knows the correction of his errors is only leading the way for him to a more accurate body of knowledge.

Science therefore deals merely with the facts of nature.

Now, it is the function of the philosopher to take the facts that are revealed by the scientists, study them, and find the relations that exist between them. Science finds the facts, philosophy organizes these

facts. The philosopher is not a researcher after truth. He is not a specialized astronomer, although he must know the findings of the astronomer; he is not a physicist, but he must give due weight to the discoveries of the physicist; he is not a chemist, but his conclusions must allow for the facts and principles of chemistry; although he is not a biologist he must not ignore what the biologist has discovered pertaining to the phenomena of life; not a psychologist, he has to take into full account what the psychologist has to say in relation to his own peculiar field of research; he is not specifically a moralist, although he is deeply interested in the larger bearings of the principles operative in the field of ethics; he is not in any restricted sense a religionist, although the facts of religion must be evaluated by him in relation to all other facts revealed by the other sciences. For religion is subject to scientific explanation, just as truly as psychology, biology, chemistry, physics, astronomy or mathematics.

Philosophy is, therefore, the science of the sciences. Its function is to take the findings of the various sciences, and by inductive reasoning discover and state the laws of their correlation. Philosophy's task is the dovetailing of the sciences. Any so-called science or scientific theory that does not dovetail with established facts, but runs counter to them, is unscientific, out of harmony with nature and untrue.

Our purpose in this chapter is, therefore, to call attention to the harmony of the sciences, the cement-

ing relationships that exist between them, and to suggest how the separate facts of nature unite together to tell the one great, all-inclusive story. The philosopher at the close of his work should find that all the threads of human knowledge have become woven together into one beautiful fabric.

The purpose of the philosopher certainly must already be clear to the reader, because relationships and connecting links between the facts of the different sciences have been continually pointed out through the preceding pages. It was shown that no astronomer can be a good astronomer according to modern standards without making use of material supplied him by mathematics and physics and chemistry. The scientist who studies suns and stars and universes, entire systems of worlds in all their stupendous immensity, must make exchanges of knowledge with the physicist, who can throw much light on astronomical problems from his study of what is going on inside the atom. The physicist, in turn, cannot be a good physicist without making use of material from mathematics and astronomy and chemistry. The chemist, in his own research, must call to his aid the instruments of the physicist and the principles of physics in order to ferret out successfully the chemical nature of the elements with which he deals and the methods and results of their combinations. The biologist finds the principles of physics and chemistry among the very fundamentals of his science. And all these scientists agree that in their own different specialized fields the laws of

mathematics apply throughout, with unquestioned fidelity.

None of these laws of the various forms of energy ever contradict each other. For that reason what purports to be a true principle in any field of thought can be checked up and proved out by comparison with the established truths in other fields of science. If the chemist, after formulating what appears to be a chemical law, finds that his supposed law runs counter to and conflicts with an established law of physics, then he knows that there is a flaw somewhere in his reasoning and experiments. If both are correct, as stated, they absolutely will not conflict.

Just so with the biologist. After his formulating what appears to be a biological law, he checks it up with the laws of physics and chemistry in order to prove its accuracy. If his findings in biology nowhere contradict the established formulas of physics and chemistry, then he is prepared to reduce his biological law to words with some assurance of its reality. But if his proposed biological law develops points of conflict with proven physical and chemical laws, then he knows beyond peradventure that he has not yet found the biological truth of the matter.

The same principle obtains throughout all the sciences. Just as biology is bound by strong ties of attachment to chemistry and physics, so psychology is related to biology and chemistry; and the still higher science of ethics and the science of religion

are on the closest terms of companionship with the sciences of psychology and biology and chemistry.

How, then, can that man concerned particularly with the higher sciences of ethics and religion insist upon the accuracy of his ideas if he ignores well-nigh completely those other special sciences with which ethics and religion are so intimately and positively related?

Conversely, it must be as emphatically pointed out, the representative of the physical sciences needs to school himself to be just as ready to square his physics and chemistry with the truths of the higher sciences, including the science of religion. Every discovered fact of nature must be squared with every other fact discovered, no matter whether it belong to the realm of religion, biology, chemistry, physics, astronomy or mathematics.

All this, I say, has been repeatedly pointed out in the preceding pages in the chapters on astronomy, physics, chemistry, biology, psychology and ethics. We have continually been indicating the harmony of all nature, and thus viewing the work of the separate sciences through the eyes and with the mind of the philosopher.

The mutuality of all nature stands clearly revealed. No science stands alone, no science could stand alone. Each is but a cog in the one great wheel, and all join hands to form an orderly systematic cosmos. No fact of nature has ever been discovered anywhere which does not harmonize with the other facts of nature everywhere.

Now this is all-significant. That point cannot be overemphasized. For we are discussing a very fundamental fact of orientation pertaining to the care of the whole of things. It affords us a peep at the work of the Creator in its grandest perspective. This principle holds within the sweep of its embrace the entire universe and every individual fact therein. It is probably the grandest thought that can come to the human mind, this principle that everything in existence throughout the cosmos is inter-related in harmonious fashion by absolute law with everything else; and that not a single truth anywhere conflicts with any other truth anywhere else.

Can any flight of fancy, any wildest dream of the imagination, any thought or viewpoint presented by all the creeds of all the churches, approach this one in magnificence and sublimity? Can any of the strange stories fathered by any of the religions of any time approach this one stupendous principle for Godlike perfection and grandeur? Does not this finding of the twentieth century philosopher put to shame all the silly and petty differences over religious creeds about which men have quarreled through all history?

For the sake of fixing the fact of the interlocking of all the parts in nature more securely in our minds, a very brief review, which might ordinarily be tiresome, may be in order here.

Turn for a moment to the abstract science of mathematics, which may be considered the basic one among the sciences. The very fundamental prin-

ciple of mathematics is harmony and exactness. It is the harmony of numerical values. The principles of addition and subtraction are in perfect harmony with the principles of geometry, trigonometry, algebra, calculus and all the high reaches of mathematics. If the slightest clash or failure occurred anywhere up and down the line of mathematical truths, our present edifice of mathematical knowledge would topple like a house of cards. Instead of order and law all would be disorder and chaos.

And if the principle that all truth is harmonious be correct, then the truths of mathematics absolutely must be able to continue to play their useful offices when they join the truths of the other sciences. Investigation proves this to be the fact.

The astronomer, searching out the truths of heavenly bodies, cannot get very far in his science without calling on mathematics for aid. First, the truths of mathematics help him to solve the riddles of the universe, and then the truths of astronomy check up, prove and correct our mathematical formulae. We are having a demonstration of how astronomy comes to the aid of mathematics in the astronomical observations that have been made recently to check up the correctness of the statement of mathematical law in the Einstein formula.

Although the interest of the physicist lies in another entirely different field of truth, the constitution and nature of energy and matter, mathematics and astronomy continue their usefulness in this new field. Just so the chemist finds that he can hardly

begin the study of his science without asking the physicist to tell him the nature of the elements. The correct understanding of chemical action and reaction between the atoms of different elements is dependent on the truths revealed by the physicist as to the composition and nature of the elements. It is the electronic and protonic structure of the atoms that accounts for chemical affinity and valency, and for the particular ways in which the different elements under the manipulation of chemical action and reaction, produce absolutely new substances.

Likewise, the facts of physics and chemistry continue to add to their usefulness when they are joined to the facts of biology. The biologist, in his study of every living thing, from the microscopic cell that floats in water and all the various forms of vegetable and animal life up to and including man himself, finds no disturbance to orderly process and perfect law, the interlockings between his biologic laws and the principles of physics and chemistry being perfect.

And so we might continue up all the ladder of the sciences to show that cosmic laws never contradict, but that each lower science continues to be of service to all the sciences occupying higher rounds. The philosopher, gathering together into one survey the facts of the various fields of research, finds them all absolutely companionable and interrelated. The truths of any one special science are but spokes in a single great wheel; meshes in the one great net that makes the term uni-verse no misnomer.

Human progress in the realm of scientific research has been so rapid in recent years that, when we stop to think, we realize that most of the notions which men of old accepted as truth had comparatively little exact knowledge back of them. Their *ideas* of truth could hardly be in harmony with absolute truth. In order to approach as near as possible to comprehending truth, it is obvious that we must be familiar with and depend upon the very latest findings of investigators in every field of research.

We know that our minds must stand in more or less imperfect relation to the truth, the whole truth and nothing else but the truth until we learn to see and understand things exactly as they are. One big difficulty in the way, which we must recognize, is that we already have many ideas carried up from childhood, imparted to us by those with meager knowledge of the truth as science knows it today—ideas not in conformity with things as they are, but mere speculations of uninformed minds. These faulty ideas form a real hindrance to most of us, because we have little power to set aside our old ideas that have been long retained, even though they are based upon inexact knowledge. Nevertheless, the mind that fails to do this, or has not the willingness and the will to do it, obviously *can not* or *will not* see truth as it really is. Yet that is the great necessity. We must force the doors of our minds open to new truth, and drop such old ideas altogether as new truth proves erroneous.

Since we find ourselves, then, face to face with

the wonderful fund of information which the sciences provide in regard to the cosmic laws of energy, electric, chemic, biotic and psychic, is there anything else for us, as sensible people to do, except to overhaul our personal philosophy and improve it all we are able?

The sciences and philosophy alike, therefore, have revealed to us the fact of a universal system of truth. That is the one great, all-important reality. Our task is to understand it, and to harmonize our philosophy in accordance with the ultimate facts of nature so far as it is possible for us. It, therefore, becomes necessary for us to consider the essential nature of pure Truth. Our minds can never fully comprehend the facts of nature. Therefore our ideas of truth can only approach but never fully harmonize with the ultimate truth of the universe. Therefore we must recognize the fact that

Truth is absolute; our ideas of truth are but relative.

Truth consists of those facts and realities that exist in the very nature of things throughout the universe—all facts, material and spiritual, embraced by all laws of matter and energy; facts and laws which have been operative throughout the cosmos through the eons of time that preceded man, and which operate now independently of anything that man can do. Truth is the absolute, the supreme, the ultimate, the unchangeable, whereas man's knowledge and beliefs can only approach toward but never attain the full reality of Truth.

This wonderful fund of information revealed by all the sciences in regard to the laws of energy is the *only safe guide* of our thinking. No religious belief that conflicts with the laws of nature can possibly prove a safer guide. No matter by how many millions of people such a belief may be held, that statement would not need to be changed. For truth is not only infinite, but it is eternal and unchangeable. Truth is the ONE GREAT GUIDE, and he who closely adheres to it cannot possibly go wrong.

And it is the absoluteness and unchangeableness of truth that are responsible for the faculty of reason in man and its expansion. If truth were not absolute and unchangeable there could not possibly be any such thing as knowledge, or reason. All would be insanity in the mind of man throughout the universe. In fact, without truth being infinite, absolute, eternal and unchangeable, no such a universe, or world, or man or mind could ever have come into existence or could continue to exist.

Truth is Omniscient. The truths of the cosmos, a few of which have been called to attention, are the sum total of all possible Intelligence. Truth is all-knowing, and there is nothing outside the pale of truth that can come within the scope of knowledge. Truth encompasses all that may be suggested to us by the expressions, Infinite Mind, or the Mind of God. Truth embraces all, comprehends all.

Truth is Omnipotent. The energies revealed by a study of the specialized sciences, a few of which have been suggested in the former chapters, are the

energies of the universe. All together they constitute the total energy of the cosmos, all-powerful, bringing about all things that transpire. Every discovery of energy is but the discovery of a new truth. There can not be the slightest trace of power or energy aside from truth. All of our discoveries of the forces of nature are but the uncovering of truths. And all the truths of nature, known and unknown, represent the sum total of power throughout the cosmos.

Truth is Omnipresent. It should be equally clear that truth is present in every part of the universe. It is unthinkable that there should be a place where truth and nature's laws do not apply. And truth is found to be not only everywhere, but everywhere the same.

Truth is Irresistible. Truth clearly being Infinite, Eternal, Unchangeable, All-knowing, All-powerful and everywhere-present—it is clearly irresistible. Intelligence in our religious and philosophic thinking compels us to shape our creeds strictly in harmony with truth. It should be very clear, therefore, that the religion of the future must drop the old beliefs now shown to be out of harmony with the laws of nature and that it must write a new creed in strict harmony with the truths of the cosmos. Anything less drastic is vain and will inevitably lead to disaster.

One of the most beautiful concepts of truth is that of its absolute *stability.* The slightest truth needs no support. You can attack it from every

angle, hurl endless untruths at it, ride over it rough shod, treat is as roughly as you will; and after you are all through it is still there, the simple plain truth, not injured in the slightest, standing intact and unscathed after every possible attack.

Every untruth, or even inaccurate statement guilty of slips in its endeavor to express truth, will sooner or later be found out and shown up to be in conflict with the eternal verities. Efforts to sustain an untruth call, not for truth, but for other untruths; but never can any structure of untruth be built, however large and complete, powerful enough to overthrow one simple truth. Conversely, no fortress of untruth, however strong and however much supported by other untruths, can withstand the attacks of truth and reason, but must stand in awe of every single truth.

As has been suggested, untruths of twenty centuries are overturned by a single fact.

Such is the nature of Truth. On this we are all agreed. Truth always withstands every attack. Truth stands unmoved.

The truth is always *right*. Can any thinking man for a moment support the paradoxical idea that any truth can be wrong? Of course not. It is unthinkable. Truth is right, and right is truth. The words are practically synonymous. Yet, strange though it be, we do see men active in church work who undoubtedly desire to do right, refusing to accept established truths of the cosmos which conflict with certain old church doctrines which they admit are not

open to demonstration. Since the sum of all our knowledge stands back of the principle that one truth never collides in contradiction with another, it is obvious that the truths of religion must harmonize with the truths of the cosmos. To square the truths of religion with the truths of the cosmos will occasionally require a revision of church doctrines. Can it be right to deny and combat the whole body of the known truths of the cosmos for the sake of holding to doctrines that originated in the Dark Ages, or before?

Truth being right, touches human welfare in every phase of life, is concerned with our every thought and word and deed. It enters into the most minute things connected with our daily affairs as well as the great ones that concern all eternity. No truth is of little or no importance. Yet the nobler the application of truth in our lives the more important it is that we understand it aright. And since religion deals with matters of such tremendous import it is imperative that we do not take for a truth in religion anything that refuses to square itself with the established truths of the cosmos.

The church deals with morality in this life and our conceptions of life beyond the grave. For centuries human minds by millions have been tortured by faulty conceptions in regard to these great concerns, speculations that had never been checked up. Obviously the religionist should be deeply concerned above all other men that his *conceptions* agree with Absolute Truth. Every established cosmic law of

energy, indeed, electric, chemic and biotic as well, is of the very greatest interest to him, and he of all men must see to it that his religious belief and teaching be in accord with the established order of the universe, and with the one great harmonious system of truth.

The cosmic laws of energy are self-consistent. It is also true, as we can clearly see, that each cosmic law of energy is related to and works in harmony with every other cosmic energy law at any and all points throughout the cosmos. Cosmic law enforcement never contradicts itself. A truth that is found in a tiny atom by the aid of a powerful microscope *must* harmonize with and *does* harmonize with the truth that the astronomer finds a million light years out in space.

Absolute truth is expressed in the laws which we find operative through the universe. In these laws we find higher and lower degrees; yet in all these there is no disharmony, and every law works in harmonious co-operation with every other law.

In our American system of jurisprudence the Constitution of the United States is the supreme law of the land. Under this supreme law are listed our federal statutes, then our state statutes, and our county, city and village ordinances. The supreme law of the Constitution does not in the slightest take away from the dignity, or the force of the local laws; but all these laws are designed to work in harmony both with all other lesser laws everywhere, and with the Supreme Law.

Far more perfectly than our man-made system of federal, state, county and city laws, the various laws of cosmic energy—the truths of nature—work in harmony with each other. For instance, everywhere throughout the known cosmos the law of gravitation is in operation twenty-four hours a day. But in the depths of the sea the fish may at will sink to the bottom or rise to the surface by means of the laws of buoyancy; or the flying fish by application of the laws of momentum may even rise above the surface of the water and travel for a distance in the air. But though the laws of buoyancy and of momentum take precedence of the law of gravitation for their special purpose, yet once their impulse begins to flag, the law of gravitation begins to get the upper hand again and resume its sway; there is not even the suggestion of a conflict between them at any point in the transaction. So it is with all of nature's laws.

Remembering the principle that one truth of the cosmos never collides in contradiction with another, we must keep in mind the fact that scientific truth deals with moral and spiritual affairs just as surely as with astronomy and physics and chemistry. We have carelessly been in the habit of thinking of the sciences as dealing only with physical affairs. All the various sciences are closely interrelated, parts of the one great system, because this cosmic energy with the single identity is at work in them all, performing different functions. No one of the so-called specific sciences could be left out without wrecking the

system, and no one of the higher sciences can be pursued intelligently without a good all-round working acquaintance with those that are lower down the ladder of the sciences.

Religious science calls attention to certain truths, while physical science, biological science and psychological science bring forth other truths. But these laws special to one form do not interfere or conflict with the laws special to another. Philosophy takes all these from all the sciences, finds their interrelations, and seeks to put them in their proper places and organize them into a self-consistent whole.

We must realize that the high position of truth cannot be over-stated. There can be nothing higher than truth, nothing else so high, so authoritative, so absolute. Truth is Infinite, Eternal and All-powerful. Truth is the ALL-HIGH.

Truth is necessarily an essential character of the nature of Divinity. Divinity *must* be truthful, else it would not be divine. The lack of truth, and the presence of falsehood, error, conflict, are unthinkable as attributes of Divinity. Divinity, in order to be Divinity, must be all truth, all goodness and perfectly self-consistent. It is truth, the source of truth, and the sum of all truth.

One of the first things we must do then, is to straighten out our own careless habits of thinking. There has been altogether too much needless crooked thinking and crooked teaching in the past. *We must see Truth as positively Divine,* and realize that the man who is really searching for the truths of the

cosmos and endeavoring to comply with them is showing the very highest reverence to the All-High.

Realizing then the divine nature of truth, there can be no spirit of irreverence in seeking truth. Indeed, reverence for God *demands* that we seek truth. In this search we draw nearer to the Infinite. There can be no higher calling for a man to choose than to spend his life in research work, penetrating the unknown, finding out more and more concerning Nature's facts and laws, and telling the world of his discoveries.

Orthodox religion has almost utterly ignored the divinity of natural law and I am here using the word divinity in the sense of "pertaining to the absolutely Supreme." Professor E. G. Conklin has pointed out that "As long as a view is held that God is not present in natural laws, the conflict between science and theology must continue."

The religion of the future will fully recognize the divinity of natural laws and that there is no divine law that is not natural. This brings the new theology into absolute harmony with all the truths of the cosmos. Thus in the religion of the future there cannot possibly arise any conflict between science and theology incapable of settlement to the common satisfaction of all parties concerned.

Until we can discern divine will in natural laws, "sermons in stones and God in everything," we have not risen to the heights wherefrom we can survey the crowning majesty of revealed truth. Until then,

we are deprived of the vision which enables us to interpret all nature in terms of Supreme Authority.

> "Truth has such a face and such a mien,
> As to be loved needs only to be seen."

We ought to love truth for its own sake. This seems perfectly clear; so obvious as hardly to necessitate affirmation. For there cannot be a nobler thing than truth, because truth is the stern reality that exists in every atom through the universe, in every bit of the cosmos, every moral principle, everything that exists. This alone is real, this alone really exists. This is the sum of all reality. This is God.

With the divine nature of truth in mind, it is clear that if we would be true to ourselves and true to the Creator of all things, if we are really desirous of acquiring a larger and larger knowledge of that Power, we must reverence the law and order operative in the works created; but first we must become acquainted with them.

And we must ever keep in mind that as we acquire more and more knowledge of the truths of nature, we are drawing closer and closer unto an understanding of the Infinite; and the more carefully and consciously we co-operate with these divine laws, the closer our lives are in harmony with Deity.

This point of view in regard to the truths of nature gives us newer and much more powerful *reasons for religious faith,* but it is a religious faith of a new order.

We are on the eve of a decided religious advance in our interpretations of the cosmic laws as revelation of divine truth. The findings of science now permit men to penetrate still further in their understanding of the nature of divinity, and of the omnipotence and omnipresence of Deity. The sciences give us a great many specific, very convincing incontrovertible reasons for religious faith—a faith based upon the massive, solid foundation supplied by a consideration of all the available facts. Thus, through a knowledge and appreciation of the divinity and majesty of the cosmic laws and their enforcement, we may arrive by way of a sane philosophy at a reasonable religion; one that satisfies the ethical standard required by our highest spiritual and moral concepts; one in which God is revealed in a manner thoroughly acceptable to our intelligence. The religion of weak and wavering faith gives place to the religion of strong and abiding faith because of the lavish re-enforcement of assurance supplied by an endless fund of exact knowledge.

This fund of divine truth is, therefore, in the language of the religionist, the word of God; in the vocabulary of the scientist, the facts of nature; to both, the universal expression of infinite intelligence, power and goodness. Therefore the love of Truth is, and should be, recognized as the highest possible moral attitude; and active co-operation with cosmic laws the highest task that can engross the mind of man.

Considering the status of orthodox religious be-

lief today it seems clear that a new religious interpretation of the cosmic laws of energy and their enforcement is necessary. It seems very clear that from now on our religious beliefs will have to be revised and kept in harmony with the truths of the cosmos established by the latest discoveries in the fields of scientific research. We must not allow former *beliefs* to control our minds and stand in the way of revision. We must remember to act up to our knowledge that the only possible means of making mental and spiritual progress is to drop faulty doctrines and wholeheartedly accept new truth.

It is obvious, therefore, that if our religious thinking is to be sound, constructive and truthful we must dare to face and accept the work involved in this task of somewhat frequent revision. If our religious interpretations be correct we can *always* dare to be true to the truth. It is inconceivable that a religion worth any man's preservation should find it in the slightest degree necessary or desirable to shrink from the most insignificant truth.

This must be clear: THE ONLY MORAL UNDERGIRDING FOR THE NEW RELIGION IS THE TRUTH! FAULTY DOCTRINES MUST BE DROPPED WHEREVER THE LIGHT OF TRUTH SHINES IN.

"Truth, crushed to earth, shall rise again,
Th' eternal years of God are hers.
But error, wounded, writhes in pain,
And dies among its worshippers."

A great change in religious thought is imperative. But we are naturally very much averse to change. Yet cosmic law enforcements, changeless itself, is everywhere bringing about changing conditions and results. Even in the matter of religious belief, slow as its evolution has been, the operation of the universal law of change is manifest. As this point is crucial for many whose aversion to change is strong and stubborn, especially in religion, we shall try to show how idle is all expectation of finding a way of escape from the task of revising our religious beliefs periodically.

Nature's Law Brings Continual Change

Paradoxical as it may at first seem, "there is nothing permanent but change."

Nowhere throughout nature do we find anything really permanent. The mountains slowly disintegrate and wash down to the sea. That soft sediment turns into stone on the sea bottom, and the earthquake lifts these strata of stone again above the sea into mountain ridges that are again weathered down to the plain. The very waters from the oceans are lifted into the clouds, carried from place to place, and sooner or later dropped again upon the surface of the earth and returned to the sea.

All vegetable and animal life the world over has its time of beginning, its time of growth and its time for decay. Nothing stays put, nothing is permanent. The great oaks that live for hundreds of years, or the giant sequoias of the Pacific coast

mountain regions, which date their birth prior to biblical times, are undergoing slow but sure change and sooner or later must bow their tall heads to the earth, be disintegrated and mingle again with the elements.

The very stars themselves are undergoing continual change. They run their life's course, even as man must do, and sooner or later must pass into something else than that which they now are.

And we are now learning that the elements themselves, which we used to believe were permanent, are really subject to change. In the case of the radioactive elements, such as radium and thorium, change takes place before our very eyes. These and the other metals of complicated electronic structure are throwing off particles of themselves and sooner or later will cease to be that which they have been and their less complicated residue will be called by other names. Here is an object-lesson in the evolution of the very elements.

Proud man, who likes to feel that he is an exceptional feature in the works of creation, is himself subject to this same law. From birth to the grave he is undergoing continual change. Every minute, every hour, every day, many changes take place in his blood and brain, and brawn, and mind and heart and soul. He is not today what he was yesterday, nor will he be tomorrow what he is today. Everything that he sees or hears or thinks or does—in short, every contact with his environment is having an effect upon him in various ways. The very

changes that are going on in his surroundings make changes or readjustments upon his part absolutely necessary if he is to keep his place in nature.

Look at the world today. What a tremendous change in sociological conditions from a few short years ago! Sociology, the science of the relations between men and groups of men, is subject to the same inroads of change. In the relations between man and man, between business and business, between nation and nation, constant readjustment is necessary owing to the constant changes going on. Between nation and nation new problems must be solved, problems that never arose before because recent changes have brought about entirely new conditions, and new agreements must be reached in regard to them.

When all life, animal and vegetable, all geology, all astronomy, all the sciences, all human knowledge give their testimony to the universal fact of change, can any man hope to make himself the one great successful exception? The man stubbornly averse to any revision of his religious beliefs should keep saying to himself: There *is* no exception; there is *no* exception; there *can be* no exception to this universal law of re-adjustment. For natural laws, unlike man-made laws, are always enforced. There is no possible escape. We must recognize the absolute fact of the law of change, and either go forward with it or be destroyed by it. There is no other alternative.

If we co-operate with that law of re-adjustment

and thus turn it to our advantage, we shall make progress and rise to higher levels. If we look down on the operation of that law, or if we endeavor to combat it, or even passively neglect to co-operate with it, the result must inevitably be of the unpleasant character that comes to every man, every plant, every animal, every atom of matter, every planet and sun and star that finds itself in conflict with a controlling law of nature. We must pay the penalty of injury or destruction, just as everything else in all creation pays a similar penalty for violations of nature's laws.

And it should be a comforting thought that change means opportunity for progress. It is only through this process of change that we have come to be what we are; change is at the heart of the very process of our creation and our upbuilding. And the process is still going on, and shall go on forever. What the future has for us therefore depends upon what the law of change shall yet bring forth, and that depends to a great extent upon how well we co-operate in readjustment with it.

Let us, then, gladly recognize and welcome the law of change and submit to the processes of readjustment demanded by it. It is a good, beneficial law. By virtue of one readjustment after another to changing circumstances, we have a reasonable hope for a better future; a better intellectual future, a better spiritual future. And just here is a good place to recall those words of wisdom by the poet Bryant:

"Weep not that the world changes.
Did it keep a stable, changeless state,
It were cause indeed to weep."

To summarize, the philosopher finds the truth of every science to be amicably related to the truths of the other sciences. They dovetail perfectly. Each higher science is dependent upon and arises out of those lower in the scale. The harmony between them is perfect, for all are under the dominion of a cosmic energy with many forms, but a single identity. If there is one thing that science and philosophy thoroughly approve it is the principle that all truth is harmonious, and that any belief found to be in conflict with the truths of the sciences is unsound and must be rejected by the intelligent mind. For everywhere, throughout the entire reach and scope of human knowledge, the philosopher finds law, order, cosmos, the work of an energy with many forms but a single identity, producing continual change. The process of evolution observed throughout all nature is perfectly consistent and natural, in view of the fact of the oneness of the informing energy. For the cosmos is a harmonious Unity.

Each science, each department of knowledge, contributes its own group of facts that blend and agree like a perfect chord of music; and all these tones are in perfect harmony with the tones of truth revealed by the other sciences; and, finally, all truths of all the sciences produce together one Grand, Harmonious Symphony of Truth.

CHAPTER XII

THE NEW RELIGION

Law, Order, Cosmos, God

The great problem before humanity today is the task of our spiritual adjustment to scientific facts. In times past the religious leaders of different peoples endeavored to interpret the Infinite to men on a speculative basis. Their interpretations gave little or no consideration to science because of a very faulty understanding of the phenomena which they observed. But today many of the phenomena which puzzled and depressed the brains of twenty centuries ago, and even three centuries ago, and which led to very erroneous interpretations of divine will are now understood quite differently. The true divine laws of nature which lie back of the phenomena have been quite clearly revealed. We are today able to make our spiritual adjustments to these divine laws in the light of scientific knowledge. For science is a rock-bottom foundation; it cannot be moved.

The spiritual values, which the church aims to uphold, are the really important issues before mankind today. Our religious teachers and leaders have realized that in them we have something of ines-

timable worth, even if we have comprehended them but vaguely, and they have very properly stood their ground here most tenaciously. But science can throw new light on spiritual affairs. Science means progress, and the discovery and understanding of more truths of the cosmos; and this applies to spiritual truths just as surely as to physical truths. In the religion of the future, the moral and spiritual values are not only preserved but strengthened and given a new interpretation in their relation to life in the terms of science and divine will, natural law.

The New Religion is therefore *the religion of the fatherhood of God, the brotherhood of man, and a universe that is home to them both. It is the Religion of Universal Truth.* It embraces the truths of mathematics, of astronomy, of physics, of chemistry, of biology and of psychology, as well as the spiritual truths of ethics and religion taught by Jesus of Nazareth. It gathers into its embrace the entire symphony of truth.

All religions of all times have been attempts on the part of different races to readjust and harmonize themselves with the Infinite. In this respect the New Religion is no exception. But it goes much further than the religions of the past because in this task of readjusting the human individual with the Infinite it can call for assistance upon all the knowledge of modern science. This means that the New Religion can never find itself in conflict with any truth, whereas all the old religions have been continually at war with other truths of the cosmos.

Man has spent perfectly enormous stores of energy upon his religions, in attempts to know and understand the Supreme Power that lies back of the cosmos, so that he might harmonize his life and actions with it. But in the past there has been very little real knowledge of the cosmos on which to work. Man's ideas of Infinity and Divinity have been necessarily very vague. But today vastly more of the nature of the creative and operative energy of the cosmos is known. The New Religion speaks out most definitely and convincingly the known facts regarding Supreme Power, and proves them by the most critical tests of the sciences, including and not overlooking the spiritual values upturned by the sciences of psychology and ethics. By this method, it outlines a creed of religious beliefs based upon the fundamental constitution of the universe and the laws of energy actually found operating therein.

In religion in all its forms there are two—and only two—great fields for thought and endeavor: 1, the promotion of human welfare, happiness and prosperity; and, 2, the maintenance of right relations with the Infinite. These are the two prime motive forces in all religious theory and practice; and both these necessities are fully satisfied by the tenets of the New Religion of Truth.

To be specific:

1. The promotion of human welfare, happiness and prosperity calls for such a knowledge and application of moral law in all human affairs, as was set forth at some length in the chapter on Ethics. But

human happiness also necessitates a knowledge of, and compliance with, the laws of psychology, of biology, of chemistry, and of physics. This makes the laws of these "lower" sciences as truly religious as are the principles of ethics, since compliance with them promotes, and a violation of them destroys, human happiness.

2. For the maintenance of right relations with the Infinite, a knowledge of nature in all its departments is a requisite of the first importance. A knowledge of the laws of cosmic energy in its various forms enables a man to know his place in the cosmos, to adjust himself properly to that place in the processes of creation, of evolution and of destruction; they teach him how to hold in highest reverence and praise the majesty, divinity, and supreme intelligence of the Infinite whom they unveil.

Thus the symphony of truth comprised in the New Religion is all-inclusive and all-sufficient. It leaves nothing real outside. It gathers into its embraces everything true and real and abiding, every sound principle and belief.

To comprehend the scope and majesty of the religion of the future, therefore, obviously calls for a knowledge of nature in the various departments of science. Such a knowledge inevitably leads into an attitude of the profoundest admiration, wonder and praise at the perfection and beauty and harmony and power of Infinite Law.

The man who learns from the sciences that many

of his former religious beliefs conflict with the facts of nature, is groping for this new orientation—the New Religion. He begins to concede that in this conflict between beliefs and the facts of nature, his old religious beliefs must give way but he does not yet see how the real values of religious experience blend in harmony with the system composed of the laws of energy in physics, chemistry, biology, psychology and ethics. In this connection the words of Pope are appropriate:

> "A *little* learning is a dangerous thing;
> Drink deep, or touch not the Pierian Spring;
> The shallow draughts intoxicate the brain,
> But drinking largely sobers us again."

"A little philosophy inclineth men's minds to atheism; but depth in philosophy bringeth men's minds to religion." (Bacon.)

The follower of the New Religion therefore will not drop, but hold tenaciously to the real spiritual values that our religions have protected and preserved for us to this time. But he also brings to this the support of the accumulated knowledge of the sciences and a new and rational conception of Infinite Power. It is a new recognition and a new faith founded on modern intelligence, born of a knowledge of the cosmos as revealed by the sciences. His recognition of a Supreme Power, arrived at through the harmonious evidence of all science is bound to give him a higher and holier reverence and faith. The nature of that Power, a subject upon which there has been much very careless and

superstitious thinking, may well receive a little further consideration here.

What and Where Is God?

All civilized and semi-civilized peoples of all times have had their rather vague ideas of their gods, but no man has ever yet been able to formulate any full or satisfactory conception of Deity. There is little prospect that he ever will. Yet it now becomes necessary and by no means unprofitable, for us to discuss briefly the idea of Deity.

The one thing revealed in nature that stands preeminent above all others is the fact of universal order, system, and law. In the minutest atoms, too tiny to be seen by any microscope, we have discovered energy at work in strict accordance with a system of laws. Throughout all nature from the microscopic, up through the visible, to the far telescopic reaches of the universe, law is everywhere and most perfect compliance with it. Here is Intelligence both in matters so minute and at the same time in matters so grand and stupendous that man cannot fathom either the minutiae or the grandeur. Right here, however, in all these maelstroms of energy applied through one system of law after another, we may approach the very closest possible to an understanding of divinity. Understand fully we cannot. We have learned something of the energies that are found existing in matter and in various forms, but beyond that matter and that energy lies the mystery of mysteries. Man may ask, whence

came this universal reign of law, this vast and perfect system, this Imposing Authority which permits no exception, this absolute harmony which knows no discord, but no man can answer. But what can we infer from what it does concerning the nature of the energy that creates all substance, brings about the changes observed in all matter and throughout the cosmos?

The astronomer may explain the birth, life, destruction, and resurrection of worlds, but his telescopes have never found the birth-place of the original energy or matter embodied in them. However, he does observe everywhere throughout the universe the existence of something to which language best approximates by the term Universal Intelligence. Everywhere he sees energy, producing things. The God of the astronomer is the God of Energy.

The physicist devotes his most delicate and intricate laboratory equipment to the manipulation of energy and the study of the structure of matter. He even disrupts atoms to find of what they are composed. Everywhere he finds energy and hand in hand with it, intelligence. Always it is energy and intelligence that participate in material changes. The God of the physicist is Energy.

The chemist takes the atoms of the physicist, and finds that a new kind of action takes place under certain conditions. Energy is at the bottom of it all. Energy creates atoms, energy makes atoms combine and produce new substances; energy and intelligence

are partners in all chemical changes. The God of the chemist is Energy.

The biologist and the bio-chemist, searching along the border line between the inorganic and the organic for the solution of the mystery of the birth of life, runs head on unto the greater mystery, the nature of the one great moving force, the intelligent energy inherent in all substances. It is that intelligent energy which accounts for all things and none of them account for it. The God of the biologist, the God which the biologist understands is back of all changes in living bodies, is Energy.

What and where is God? God is everywhere, for energy in some of its many forms but with its single identity is everywhere. God is in the hydrogen atom as truly as in the brain of man. This is the God of nature, the God which the sciences understand created all things and maintains all things according to the systems of law which we may observe. The God of energy, various in its forms but single in its identity is the God of astronomical truth, of physical truth, of chemical truth, of biological truth, of psychical truth, of ethical truth, of religious truth.

The New Religion recognizes the God of Nature, that energy, that system, that law, that order, which make the universe a cosmos and not a chaos. Of the presence and the all-sufficient power of this God of energy and cosmic law enforcement there is ample evidence everywhere.

The God of Creation.

The New Religion approaches the subject of creation in the light of modern knowledge. The astronomer, the physicist, the biologist, the botanist, the zoologist and the anthropologist find that the energy of the atom and the presiding energy that lies back of all organized structures account for the creation of all things. The astronomer knows that the stars and sun and planets and satellites were brought into existence by energy through the application and operation of systems of law, displaying high intelligence. Everywhere there is law, order, system present in the creation, development and destruction of worlds. The astronomer's God of creation is Energy.

The physicist studies the various elements, their composition and nature, the number of parts of which the individual atoms are composed, and finds creation taking place in accordance with the power back of it. The God of creation of the physicist is Energy.

The chemist draws up the formulas of new substances and he creates them practically at will in the laboratory. But he cannot create them except by the application of nature's system of chemical laws, and the product which he produces is made possible only by virtue of the chemical energy supplied by the atoms with which he deals. The God of creation of the chemist is Energy.

The biologist is deeply concerned with the

changes involved in the creation and preservation of life. Never, never has he found a way to create or sustain life without the expenditure of energy. The God of creation of the biologist is Energy.

In short, science finds that all things that are known to exist on the earth or throughout the universe have been produced by the expenditure of energy. The God of all creation is Energy.

It will be appropriate to turn now and give thought to the method or *processes* employed in creation.

Evolution as the Method of Creation and Development

The physicist has very thoroughly and convincingly shown, by innumerable laboratory tests, how strong the case is for the soundness of the law of conservation. He has never discovered anywhere in the universe nor in all his laboratory experiments, any evidence whatever that the slightest unit of matter or energy was ever created out of nothing. It is true that it is easy to produce changes in form of matter and of energy; but always at an equal expenditure of matter or energy in some other form.

The physicist finds existing in the universe a vast amount of solid matter and fluid energy. The two so closely interrelated that it is impossible to separate them. Furthermore, the law of conservation seems to pass over, without any loss, from one to the other and include them both in its jurisdic-

tion. But never does the slightest trace in the way of change of matter or energy occur without an exact expenditure of its equivalent in some other form.

Everywhere about us, visible in thousands of places and ways, we come upon nature creating new things by a process or method of transformation. Note that this is not a creation of matter *de novo* or energy *de novo,* but a creation of new *forms* out of old. This has been shown with sufficient clearness perhaps in the chapters on physics, chemistry and biology.

The point that it is very important here for us to get clearly is that the method of creation of all things physical and all things spiritual is this method of the formation over again of old into new, which may be actually demonstrated in many an instance. The physicist shows that by a certain combination or formation over again, of protons and electrons, the inert gas helium is created; by another slightly more complex formation over again of protons and electrons the very simple element carbon is produced; still another more complex formation over again produces the element sodium; and by this same method still more complex structures of the atom are produced that display the characteristics of phosphorus, sulphur, iron, nickel, zinc, silver, tin, mercury, radium, etc. Notice that here is taking place the actual *creation* of *elementary substances* having entirely different characteristics as to weight, color, hardness, chemical affinity, and

valency, but always at an expenditure of an exact equivalent of older material and energy in conformity with the law of conservation. Here nature permits us to catch her in the very act of making or creating the bricks out of which she builds the edifices of the worlds.

Take notice that this means that even in the very beginning, in the case of atoms so exceedingly minute that they cannot be seen by any microscope, the method of creation used is a process of evolution or development into increasing complexity of structure by successive formations over again of the old into the new. This is the natural law of creation of new things in force in the realm of the elementary substances, so called.

Examine again into the method used in the combination of these elements with each other, which takes place within the realm of chemistry. New substances are created by the chemical combination of two or more elements. Thus edible table salt is made from the chemical formation over again of poisonous chlorine and sodium. This is nature's process or method of creation in the case of salt. It is not made out of nothing, but it is made out of chlorine and sodium by their chemical formation over again into a new combination, according to a very exact mathematical law.

The eighty-nine known "primary elements" are comparatively simple substances, but the chemist has shown that these can be made, by chemical formation over again, to unite in varying numbers so

as to produce a practically innumerable variety of new substances. The laws of physics and of chemistry describe the method of creation of all the mineral substances found on the earth. It is a process of development or production by the formation over again of the old into the new in accordance with a system of natural laws; not a process of creation by fiat out of nothing. All minerals now found on the earth have been developed by the method of forming over again the old into the new in harmony with the laws of affinity and valency and in keeping with the law of conservation, which is universal in its application. This method runs true to form in the realm of physics, in the realm of chemics and in the realm of biology and in the spiritual sciences of psychology and ethics as well.

The chemist knows nothing whatever of any method of producing any compound without the use of the elements of which it is composed. Furthermore, all known substances and combinations are directly traceable back to the primary elements as their antecedents. No material thing has ever come into existence in the universe, so far as we have any slightest evidence whatever, which was an exception to this method of development in orderly fashion by process of natural law as pointed out by the astronomer, the physicist, the chemist and the biologist.

Following the chemist, the biologist has shown

that the very basis of life, the protoplasmic cell, has come into existence by the forming over again of old material, provided in the form of atoms, chemical combinations, and colloid structures in absolute harmony with laws peculiar to this biological realm. No biologist ever found a single living cell coming into existence out of nothing or apart from the ancestry just described. They are produced by a process of forming over again older, simpler structures into newer, more complicated ones. This being true, certainly a living creature composed of practically innumerable atoms, chemical combinations and cells, beautifully organized, and working in harmony with physico-chemical laws, could be brought into existence only by the continuation of this method of creation used in creating the older parts of which it is made; and doing it in accordance with the new laws of the new realm of biology to which it belongs.

The fact of the evolutionary process of creation by successive formings over again of older material into something fresh and new, is supported by abundant evidences present in all the pertinent sciences. The astronomer, searching the heavens with his great telescopes which span such vast distances that he knows quite intimately not only this universe but hundreds of thousands of systems that lie far outside our own galaxy, everywhere sees creation at work by means of the processes of change and development. By the aid of his spectroscope he analyzes the nebulae and the stars, both those close

by and those exceedingly remote, and everywhere finds evolution or development going on, forming over again older material into something fresh and new. Worlds are born, developed, reach their glory, and die of old age. Entire systems of worlds are thus seen to be "in process," and even the rapidity of some of the changes taking place has been calculated. Every astronomer knows as a matter of scientific observation that creation by the method of evolution or development is a fact of nature.

Just as the astronomer observes creation at work by this method of successive formings over again of older material into something new and fresh, proceeding on the most vast and extensive world scale, so the physicist sees creation at work by this identical process of evolution or development on a relatively smaller scale. Furthermore, he sees this method of creation in force both in matter and in energy. Nowhere can the physicist find a place where creation is not going on by this method. The law of creation by successive formings over again of older material into something fresh and new seems to be as universal as the law of gravitation.

In the chapter by the chemist this process of creation by the method of developing newer forms from older was proven by the very basic principles of that science and demonstrated in every detail of its operation. The application of chemic laws brings change, development, evolution, growth, creation of the com-

plex from the simple, under the appropriate conditions.

If there is one fact of biology that is truly fundamental and takes precedence over all others it is the fact of creation by this method of growth or development or evolution. It can be observed going on in every plant and animal on the earth, in the changes that take place from birth until death. But the law of creation by the method of successive formings over again of older material into something fresh and new applies not only to the individual, but to the species and to all life as a group. The laws of heredity are now becoming much better understood and the way creation uses this method of forming old species over again into new ones is demonstrated in the laboratory. Luther Burbank has produced a number of absolutely new species of plants. Innumerable evidences go to show that this law of creation by the successive formings over again of older material into something new and fresh accounts for all the species of life found on the earth.

Again the science of geology puts forward its different but very substantial evidence that evolutionary changes have taken place on the earth. The laws and processes by which it shows the earth was made and their connection with astronomy all indicate that its creation was a process of very slow development. Geology sustains evolution and this one science, even if not supported by the other sciences with their vast additions to the evidence, would alone be more than sufficient to show it to be

the order and method of the creation of the earth.

Again, the science of paleontology does little else than draw the map of the general course of development of animal life on the earth, and clearly prove the fact and even much of the order of evolution of life.

We may as well admit it: in the long ago the material of which the earth is now composed was in gaseous form, and no vegetable or animal life existed in it; much later, when the masses of material of which our globe is formed began to be assembled, even then no life existed. Only when the suitable chemic, atmospheric and temperature conditions were provided could life arise. Then by the method previously used of forming over again old material, the fresh, new thing that made its appearance was the biological—living forms. During the long, long ages that have followed since those times the same method that produced the original living forms influenced by the changing conditions, has gone on producing a great range and variety of vegetable and animal life. The paleontologist can testify that countless numbers of living species have ceased to exist, and countless numbers developed later to replace them.

If it were not true that new species kept making their first appearance, the earth would have been long, long ago depopulated of all life. But by the same method that formed older non-living material over again into the original living forms, new combinations have constantly been taking place, produc-

ing new life, new living forms. The process by which new living forms are produced is, generally speaking, exceedingly slow, and this has been the stumbling block in the way of its acceptance upon the part of the honest doubters. There are those who really question whether a species of animal, or a race of men, can undergo an evolutionary change. One rational thinker makes this reply to these people: "If you will sit down for a million years and watch a species develop, and compare what it is at the end of the million years with what it was at the beginning, you may detect a little change; but you must not expect any to be perceptible in the very brief time in which you are here to watch it."

Now comes along the anthropologist to tell these same doubters that man carries in his own body a large number of relics in evidence of his blood relationship with other animals. To many of them this may be an unwelcome truth. But shall they refuse the truth for that reason?

The fact of creation by the method or process of change and growth, named evolution, is proven by *all* the sciences. The New Religion heartily embraces this method of creation because it finds a world of religious inspiration in the myriad evidences of the beauty, the majesty, the lawful order of the cosmos on which the theory of evolution is based.

The God of Providence

The God of Nature, through the millions of years that man has probably been on the earth, has taken

care of man's needs and brought him up to the present state of high culture through the *providence of natural law.* For the intelligent energy with many forms but a single identity that fills the universe, not only produced man, created him, but with little or no conscious aid from man cared for the race in the days of its infancy and development. The cosmic enforcement of the laws of health, the laws of heredity, all those countless systems of law that operate for the well-being of the individual and the race are nature's God of Providence. Any man today who wants to co-operate with Deity for his own daily welfare has no choice but to co-operate with these laws of nature still in operation for his physical, biological, mental, ethical and spiritual growth. The God of Providence is the God of Nature, caring for the daily welfare of man by enforcing the systems of law adapted to that purpose.

Omnipotent, Omniscient, Omnipresent

The God of nature, Energy, is therefore truly all-powerful, all-knowing, all-present; omnipotent, because all things that have been made have been made by it; omniscient, because there is nothing more to be known than the truths of the cosmos created by it; omnipresent, because its energy is found at work everywhere throughout the universe. The conception of energy supplied by the sciences therefore measures up to the grandest conceptions which man has ever been able to evolve concerning the nature of God. Furthermore, the new conception of

God in the light of all the sciences as the intelligent energy, with many forms but a single identity, that fills the universe is a thousand times more convincing than our former conceptions of Deity.

The Bible of the New Religion

As must already be clear to the reader, the text book of the New Religion will hold within its embrace every statement of truth. No matter whether it concern the method of creation used in the making of worlds and solar systems, or in the development of life on the earth, or in the progress of man on the earth recorded in his own histories, or in the remarkable development of the mind, and the laws of man's relation to his fellow-men as well as to the Infinite—all this is truth, Infinite and Divine, and every statement of such truth makes the most sacred literature worthy of inclusion in the Bible of the New Religion.

The creed of the New Religion is clearly and definitely expressed in the systems of the laws of cosmic energy. We must learn to look upon the texts of astronomy, of physics, of chemistry, of biology, of psychology, of bodily and mental and moral health and man's just relations to other men and to all creation as but different books of a sacred Bible; each filling a place which it has made for itself in the edification and improvement of the human race, and all together constituting the most holy writings that ever came from the pen of man. Nowhere the slightest contradiction from first to last, but everywhere

the most beautiful and perfect harmony, they present a religious philosophy that not only compels our highest respect and reverence, but is truly invincible.

It is worth noting here that this Bible of the New Religion of the future is a *believable* text. Its teachings are demonstrable. Their truth and power and infinity are inescapable. The strength and beauty of this New Religion lies here; every portion of its creed is demonstrable, and every article in it is in harmony with, and is supported by, every other article. It is therefore the Religion of Universal Truth, and its acceptance must inevitably follow an understanding of the harmony and immutable power of Truth.

It should be clear to any one who thinks that a religious philosophy, which is to be of any substantial value to its possessor, must be earnestly believed. As soon as the hold of a religious creed weakens, its power to sustain and control ceases to be operative on the human mind or effective in the life. Hard and fast belief is the very breath of life in the psychology of religion; without it, there is little or no religion.

The New Religion is a believable religion, worthy of hard and fast acceptance because it harmonizes with all truth; the united findings and judgments of the various physical and abstract sciences, in harmonious agreement, impart a power of conviction to it which is invincible.

The New Religion is not only a believable religion, but it is a *livable religion.* It asks us to live

our lives day in and day out in harmony with the known laws of that energy, with various forms but a single identity, which fills the universe, in the knowledge that when we live that way we are co-operating with the All-Powerful for the better furthering of the welfare of humanity. For the Bible of the New Religion demonstrates that the cosmic enforcement of the laws of morality is not a whit less sure than the enforcement of the laws of physics or chemistry; that if we harmonize our lives with those laws of morality and spiritual health, we shall prosper; and that if we violate them we shall be punished by their enforcement. We have no alternative left us.

Here we are, then, after our long climb, at the very pinnacle of religious thought. So far as human welfare is bound up with our religious thinking, the conviction that should reign supreme in our minds should be the conviction that the way of life for us is the way of obedience to those known systems of laws instituted and enforced by the energy with a single identity that fills the universe; that in no other way can we maintain correct relationships toward our fellow-men and with the Infinite. We must recognize the brotherhood of man and the fatherhood of that divine Energy that has brought us unto our present state. The Infinite that created us controls and protects and instructs us. But the method used by the Infinite in creating, protecting and instructing us is these systems of law—that is why the laws of the Infinite constitute the Bible of the New Religion.

The New Religion therefore makes clear that compliance with the cosmic laws of psychic energy is as essential to our spiritual growth as compliance with the laws of nourishment is essential to our bodily existence. Men have found that they can live their lives about as successfully without as with many of the existing religious creeds, but no man will ever find that he can prosper or that the human race can develop about as well without as with this creed of obedience to the systems of law established by the energy with a single identity that fills the universe.

This is all-important. For, as Mr. David Starr Jordan pointed out: "The final test of truth is its livableness, the degree to which we may safely trust our lives to it."

Since the New Religion embraces all truth, it is necessarily a *growing* religion. As the sciences advance and reveal new truths pertaining to the structure and operation of the cosmos these new truths are automatically incorporated into its Bible.

Naturally, it does the same with the vast amount of new knowledge which has been acquired since the days of Jesus, and since the days when our old theology grew in the minds of upward striving men. The New Religion gathers within its embrace this knowledge because its conviction is so strong that we are under the necessity of co-operating with the laws of nature which it reveals. To its mind, this necessity points the way for human conduct in relation to the

new problems as well as the new truths that have arisen since those early times.

The problem, for instance, of right relationships between employer and employe is a strictly modern one. It did not exist in the complexity of today in the days when our orthodox creed was taking form in the minds of men. The problems of sociology are modern problems with which orthodoxy did not grapple. It is true that in the moral teachings of Jesus the basis for just social relations is suggested, and the kind of individuals that living together justly calls for clearly presented. Great new compulsions to act up to these teachings of Jesus will overcome all men's old objections and indifference when they generally learn to take it for granted that the laws of morality and spiritual good health constitute a system which is enforced with the same rigor and certainty as the laws of physics and chemistry and biology.

Again the old question of proper conduct between nations has entered upon strictly modern phases. Ethical standards of international behavior certainly have advanced very far in the last three thousand years. We concede that other peoples have rights, and it sounds good when we are told that we should be just as zealous in looking after their welfare as our own. Great new compulsions to act up to these sentiments will overcome the old spirit of greed and oppression when nations generally learn to take it for granted that "members one of another" is a

law of nature which is enforced with the same rigor as the law of falling bodies.

Other problems such as charity, punishment of wrong, hereditary influence leading to unethical action, mental incompetency and crime, personal liberty, alcoholism, physical, mental and moral requisites for marriage, economics, moral obligations of individuals, communities and nations—all these are modern questions which will receive a working solution at the hands of the New Religion in the light of science.

CHAPTER XIII

THE NEW REVELATION

The New Religion offers men a New Revelation, which frees them from many an ancient superstition. It will thus be seen that, since the New Religion is the religion of natural law, the words of Benjamin Moore here become perfectly appropriate:

"Every discovery of science becomes revealed religion, and the scientific discoverer becomes the minister of the Infinite."

There is truth in enough abundance in this suggestive statement to be worthy of special consideration. The world has never fully appreciated its scientists, the tireless, silent, poorly paid research workers of the world, who, for the very love of Truth, have spent their lives in finding more and more of it to bequeath to humanity. We realize today that these are the men who have been approaching closer and closer to the Infinite God of nature, and we appreciate more and more that the teachers of the new sciences have been the torch-bearers bringing new light to humanity. These men are real ministers of the true God, teaching more and more of Infinite Truth to an upward struggling race. From them we

receive the New Revelation of Truth through science.

The world little appreciates the tremendous additions to the common store of moral value bequeathed to humanity by the discoverers of new Truth. The teacher of science is the greatest moral leader in the world, for he proves that the cosmic enforcement of the laws of energy—electric, chemic, biotic and psychic—never fail to bless obedience or withhold their blessing from disobedience are irresistible.

The New Religion, being based upon all universal Truth, is in exact harmony with the true cosmology based upon our knowledge of the universe as a vast organization controlled and operated, both in its greatest immensity and in its minutest detail, by absolute natural law. All any man has to do is to contemplate the inconceivable vastness and perfection of this system of lawful nature and its absolute stability, its stern immutableness, to obtain a new and holy access of a kind of religious faith that satisfies.

The New Religion is therefore a scientific religion. The God it recognizes is the God of the all-pervading Energy of the universe which is revealed in the atom of physics, in chemistry, in astronomy, in biology, in psychology. The creator of all things —this is God, and this conception of God is the scientific one. Omnipotent, Omniscient and Omnipresent, the God of the energy, with many forms but a single identity, which fills the universe is also

"infinite, eternal and unchangeable in wisdom, power, holiness, goodness and truth."

Cosmic Harmony

The New Religion recognizes and indeed is elated over the harmony of the cosmos, the perfect, orderly, lawful system that prevails throughout the universe. Tiny man is but an insignificant part of the one great scheme, and his entire world is as unimportant to its own immediate universe as a grain of sand is to the seashore. Man, through his ignorance and superstitions, attempts to combat nature and thus an element of discord is introduced into it so far as he himself is immediately concerned. But always natural law applies, and even in the discord introduced by man through his failure to co-operate with natural law, and in his consequent punishment, the absolute harmony and authority of the cosmos are displayed. Every act of opposition which we may introduce in nature to combat a natural law immediately invokes a higher law which enforces appropriate and exact punishment to the violator. Thus it is absolutely impossible for man to carry his oppositions to the point of introducing chaos into the cosmos.

The New Religion, therefore, recognizes and stresses the need of cosmic co-operation on the part of men. The very highest and best things that man can do is to put forth his supremest effort to understand the systems of laws that form his environment and to do his utmost to co-operate with them.

The man who advances theories of his own which are out of tune at one or more points with the systems of laws that form our environment is unwittingly antagonizing the vast harmony of the cosmos. He is putting his own petty untruth into a losing combat. If he does that at any time, knowingly, with all the vast volume of Truth of nature, he is committing a crime against the intellectual and spiritual rights of man. Nature immediately retaliates, because it cannot help man to rise to a higher standard by means of untruth. But the teacher who earnestly studies the systems of laws that form our environment, who understands that they never clash, who is sensible of the grand forces that are at his disposal through conformity with them, finds himself carried along on a mounting tide of new vision and new power in his work.

For centuries man has endeavored to get a better grasp of the revelation of the divine will. But here spread, spread over the whole realm of nature, is a revelation of God so truly magnificent and wonderful and all-inclusive in its scope, so perfect in the minutest detail, so all-compelling in its logic, so positively truthful in every word and line and chapter, so absolutely harmonious from first to last, that even the mind capable of the profoundest thought is held in abject awe and wonder and admiration at the stupendous spectacle revealed. For the systems of laws that form our environment are the revelations of the true God, so perfect, so authoritative, so true, so

convincing, so inspiring as to compel the very highest admiration, worship and praise.

The systems of laws in which we live and move and have our being, included in the Bible of the New Religion, thus lead to cosmic co-operation as the chief duty of man. The student of them finds that God has written a wonderful book of revelation in the structure and the operation of energy in atoms, in chemical combinations, in all plant and animal life, in the structure of worlds and in the motions of planets and stars and systems of stars.

Everywhere throughout the cosmos the Creator of all things has written his Own Revelation to man, and science is learning to read it chapter by chapter with a steadily increasing clarity of understanding.

And it is all self-consistent. The chapter which the astronomer interprets and writes down is found to need no correction when compared with the chapter which the biologist translates. And both are found to coincide with all other truths found everywhere. The God of Energy has produced a self-consistent cosmos and has revealed divine will in every phase of natural law.

The microscopist who studies the actions of living forms under his most powerful instruments gets a new vision of the creative method and will of the Creator of living things; he actually sees processes so marvelously wonderful and beautiful and perfect that words cannot express his speechless admiration and worship.

Likewise the astronomer in the midst of his study

of the heavens with his giant telescopes and other instruments, is stricken speechless with amazement at the harmonious co-operation manifest everywhere, and he gets a new and higher and holier impulse to reverence and praise the unsearchable magnitude and beauty and perfection of the works of the Creator of all things.

We know today that the entire universe and all therein, in its larger as well as in its microscopic aspects, is under a perfect system of laws absolute in their enforcement. These laws are natural, eternal, unchangeable, universal. Our intelligence perceives them in part and covets perfect co-operation with them everywhere. The New Religion recognizes that man's highest ambition can only be to harmonize the conduct of his life as perfectly as possible with these divine laws. There is no super-natural; all is natural and all is revelation. What we are inclined to call supernatural is only some piece of revelation which we have not as yet learned how to translate. The New Religion recognizes that those phenomena which we cannot as yet understand may be presumed to fit into the existing system of things; that they must not be looked upon as evidence of the supernatural, given a superstitious interpretation and built into an unsound, unsupported religious belief, but must be treated as pieces of revelation which we shall one day learn to translate. On the other hand, the New Religion teaches that one of the highest and holiest purposes to which any man can devote his life is research work pertaining to

phenomena not yet understood, in the hope of discovering their relationship to other truths, in order to interlock another installment of the unknown into the system of the known.

For instance, at the present time the thinking religious world is studying the problems involved in psychic phenomena. There are those who seek to give currency to religious interpretations of these phenomena made up out of their own heads without any attempt to establish contact for their doctrines with the systems of laws that form our environment. All our fund of well-understood truth is self-consistent and all previously baffling phenomena have ceased to baffle when the laws pertaining thereto are understood. The New Religion seeks to translate the revelation hidden from us at present in psychic phenomena by hard exploring work in search of the laws which we are quite sure are in existence that will reveal its connections and relations with other truths of the cosmos known to us. Then the human race may co-operate with them and obtain the blessings of which they are now deprived because the revelation written in psychic phenomena has not yet been deciphered. Unchecked speculation leads to superstition; real understanding leads to co-operation, and co-operation means development.

Nature is all. Without it man has nothing; with it he has everything. In knowledge of the cosmos man finds his very highest inspiration, and in co-operation with it lies his greatest, his only good. Here man may find everything to satisfy his mental

and spiritual needs; elsewhere he finds nothing. In the words of Robert Browning:

> "I trust in Nature for the stable laws
> Of beauty and utility. Spring shall plant
> And Autumn garner to the end of time.
> I trust in God—the right shall be the right
> And other than the wrong, while He endures;
> I trust in my own soul, that can perceive
> The outward and the inward, Nature's good
> and God's."

The New Religion is the religion of truth as revealed by science. Its devotee may worship his God through his recognitions of the beauty and divinity of natural law that everywhere prevails, and by his endeavors to comply therewith for the good of all. He is confined to no temple of brick or stone, no towering steeple, as a place for worship. Wherever he is, wherever he looks, wherever his mind wanders, there is beauty, and majesty, and order and law, the work of the Infinite. David Vedder has well expressed the thought in his poem, *The Temple of Nature:*

> "Talk not of temples; there is one
> Built without hands, to mankind given;
> Its lamps are the meridian sun
> And all the stars of heaven,
> Its walls are the cerulean sky,
> Its floor the earth so green and fair,
> The dome its vast immensity;
> All Nature worships there!"

Holy, holy, holy are the laws of the God of Nature. Puny man can faintly understand and obey them, but he can never escape or change them. Here

the religious impulse finds the worthy object of veneration, and here we make the nearest possible approach to the Infinite. Here is God revealed, and here are the divine way and will set forth. In exact proportion as we learn the systems of laws that form the environment in which we live and move and have our being, and co-operate with them, heaven comes to us here and now.

INDEX

A

Absolute Truth, 247, 251.
Absolute Zero, 34.
Adaptive Change, 141.
Affinity, 63, 90.
African Wild Life, 230, 232.
Albumen, Composition of, 113.
Aldebaran, 30.
Algae, 140.
Alpha Centauri, 37.
American Association for the Advancement of Science, 123.
Andromeda, Spiral Systems in, Plates III. and V.
Andromeda, Spiral Systems in, 40, 44.
Anthropology, 146.
Arcturus, 30.
Asteroids, 36.
Astronomy, 26.
Astronomy of the Atom, 53.
Atom, Energy of, 51.
Atomic Number, 61.
Atomic Weight, 61.
Atoms, Table of, 59, 60, 61.
Australopithicus Africanus, 165, 166.

B

Bateson, William, 179, 180.
Bible of New Religion, 283, 285.
Biology, 96.
Biotic Energy, 89, 114.
Blood Albumen, Composition of, 113.
Brain, 114, 155, 156, 157.
Browning, Robert, 296.
Bundle of His, 157, 158.
Burbank, Luther, 143, 148.
Bushmen, 171.

C

Caffein, Composition of, 113.
Carbon, Character of, 61.
Carbon, Importance of in World, 84.
Cell, 97, 146, 147.
Cell, an Energy Transformer, 104, 105, 106.
Change, Law of, 74, 259, 260, 261, 262, 263.
Chemical Affinity, 63, 81, 82.
Chemical Valency, 82.
Chemical Combinations, 82.
Chemical Combinations, Infinite Variety of, 88, 89.
Chemistry, 76.
Chemistry and Mind, 195, 196, 200, 201.
Civilizations, Extinct, 173.

Chimpanzee, Blood of, 159.
Clusters of Stars, Plate IV.
Clusters of Stars, 41, 42.
Collision, Earth and Star, 34.
Colloids, 90, 97.
Conflict, 22.
Conklin, E. G., 255.
Conservation of Energy, 48.
Conservation of Matter, 48.
Conservation of Energy and Matter, 49, 50.
Cosmic Co-operation, 292, 293.
Cosmic Harmony, 291.
Cosmos, 22, 45.
Creation of New Substances from Old, 81, 86, 87, 88, 144, 145.
Cro-Magnon Race, 170, 171.

D

Dark Nebulae, 45.
Death, 120, 121, 153.
Diety, 17, 269.

E

Earth, Age of, 137.
Einstein, 49.
Electrical Current, 57.
Electrons, 52, 57.
Electrons, Size of, 58.
Elements, 52.
Elements, Evolution of, 69, 70.
Elements in Stars, 29, 30, 31, 69, 70, 71.
Elements Everywhere the Same, 74.
Elements Necessary for Life, 116, 117.
Elements, Table of, 59, 60, 61.
Embryo, Development of, 160.
Embryology, 159, 160, 161, 162.
Emotional Energy, 184.
Endocrine Glands, 158, 201, 202, 203.
Energy, 47.
Energy, Biotic, 99.
Energy, Psychic, 108, 131, 132.
Energy, Storage of, in Atoms, 71.
Energy, Transformation of, 104, 105, 106, 126.
Ethics, 206.
Evolution, 89, 90.
Evolution, Cause of, 89.
Evolution, Course of, 89.
Evolution of Man, Evidences of, 146 to 180.
Evolution, the Method of Creation, 273, 274, 275, 276, 277, 278, 279, 280, 281.
Evolution, Inorganic, 54.
Evolution of Substances, 85, 86, 87, 88.
Evolution, Present Status of, 123, 124, 125, 180.
Extinct Species, 141, 142, 167.
Eyes, Kinds of, 155.

F

Fatherless Animals, 121.
Fissure of Rolando, 156.
Fossils, 140, 165.
Fundamental Law of Growth, 99, 100, 101, 103, 114.
Furnaces of the Suns, 72.

G

Galaxy, 38, 41.
Gamma Argus, 29.

Genealogy of Certain Elements, 68.
Geology, 133.
Geometry, Euclidean, 49.
Gibson, Robt. Wms., 233.
Gill Slits in Embryo, 160.
Gluten, Composition of, 113.
God, 17, 19, 20, 56, 282.
God, What and Where is, 269, 270, 271.
God of Creation, 272, 273.
God of Providence, 281, 282.
Golden Rule in Different Religions, 211.
Grand Canyon, 136.
Growth, Fundamental Law of, 99, 100, 101, 103, 114.

H

Haemoglobin, Composition of, 113.
Hair of Embryo, 162.
Harmony of Cosmos, 239.
Harmony with Cosmos, 295.
Harmony of Truth, 239, 241, 242, 243, 244.
Heart, Development of, in Embryo, 160, 161.
Hearts of Different Classes of Animals, 160, 161.
Heidelberg Man, 168.
Helium, 29, 73.
Heredity, 146, 148, 149, 165.
Hydrogen, 29, 61.

I

Ideas of Truth, 247.
Immortality, Belief in, 186.
Inorganic Evolution, 54.
Insect Feeders, 128.
Instinct, 152.
Intelligence, 56, 129, 130.
Iron, 26.

J

Jesus Christ, 23, 234, 265, 287.
Jupiter, 32.

K

Kant, Immanuel, 237.
Kidneys in Embryo, 161, 162.

L

Life Energy, 105, 116, 148.
Life, History of, on Earth, 138, 144, 172.
Life Measured in Heat Units, 112.
Life on Other Worlds, 38.
Life, Origin of, 99.
Life Process, 92, 93, 94, 116, 120, 121, 122.
Light, Effects of 77, 87, 88.
Light, Velocity of, 42, 43.
Lungs, Development of, 161.

M

MacFarlane, J. M., 94, 224.
Man, Comparison of With Animals, 146 to 180.
Man, in Relation to Universe, 44.
Mathematics, 244.
Matter, 47, 48.
Matter, Disappearance of, 49, 50.
Mental Energy, 193.
Metals in Stars, 30.
Milky Way, 39.

Millikan, Robert A., 57, 79, 211, 212.
Molecule, 75, 96.
Moon, 34.
Moral Law, Cosmic Law, 209.
Moses, Moral Law of, 233.

N

Neanderthal Race, 168, 169, 170.
Nebulae, 27.
Nervous Energy, 193.
New Religion, 264, 265, 266, 267, 268, 269, 270, 271, 283, 284, 285, 286, 289, 290, 296.
New Revelation, 289.
Nitrogen Important to Life, 85.
Novae, 35.
Nutrition, 93, 94, 95.

O

Omnipresence of Truth, 249.
Omniscience of Truth, 248.
Organs, 107, 146, 148.
Orion, 29.
Osterhaut, W. J. V., 118, 119.
Oxygen, 61.

P

Paleontological Facts, 33, 139.
Philosophy, 17, 238.
Phototactic Sense, 126, 127.
Piltdown Man, 169.
Physics, 47 to 75.
Pitcher Plant, 128.
Pithecanthropus Erectus, 166.
Planetoids, 35.
Pleiades (Plate I.)
Pleiades, 27.
Polaris, 30.
Procyon, 30.
Psychic Energy, 108, 131, 181, 182, 183, 193, 194.
Psychic Phenomena, 295.
Psychology, 181.
Pulsation in Plants, 112.

R

Radioactive Elements, 33, 62.
Radioactivity, 62, 66.
Radium, 61.
Reason, 187, 189.
Recapitulation of History of Race, 160, 163.
Relics in Human Body, 162.
Religion, 17, 185, 188.
Reproduction by Sex, 121, 147, 150.
Rutherford, Sir Ernest, 66, 67.

S

Sciences, Harmony of, 239, 240, 241, 242, 243, 244.
Selenium, Effect of Light Rays on, 77.
Sexual Reproduction, 121, 147, 150.
Shakespeare, 237.
Sirius, 29.
Slosson, E. E., 68.
Solar System, 36.
Species, New, 141, 143.
Species, Extinct, 142.
Spectroscope, 277.
Spiral Systems (Plates III. and V.)
Spiral Systems, 40, 43.
Stars, Chemical Analysis of, 277.

Stars, Classification of, 28.
Stars, Clusters of, 41, 42.
Star Systems, Organization of, 41, 42, 43.
Starch, Composition of, 113.
Starch, Development of, 119, 120.
Stratified Rocks, 134, 136.
Supreme Intelligence, 22, 45, 56, 122.
Supreme Power, 266.
Supreme Will, 24.
Symphony of Truth, 263, 267.

T

Tail, Human, in Embryo, 163.
Temperature of Stars, 29, 30.
Thyroid Gland, 109, 158, 159.
Transformation of Energy, 104, 105, 106, 126.
Transmutation of Elements, 72.
Truth, 247.
Truth, Absolute, 247.
Truth, All-high, 254, 258.
Truth, Divine, 254, 257.
Truth, Harmonious, 241, 242, 243, 244.
Truth Irresistible, 249.
Truth, Omnipotent, 248.
Truth, Omnipresent, 249.
Truth, Omniscient, 248.
Truth, Right, 250.
Truth, Self-consistent, 252.
Truth, Stable, 249.
Truth, Symphony of, 263, 267.

U

Universal Intelligence, 270.
Universal Truth, 265.
Universe, Shape of, 43.

V

Valency, 82.
Variable Stars, 31.
Vedder, David, 296.
Venus Fly Trap, 128.
Vestiges in Human Body, 162.

W

Water, Composition of, 85.
World's Life History of, 26.

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